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CF-031, 032, 034,
CF-035, 036, 037

**PORTABLE
FFT
ANALYZER
CF-300 OPTION**

**INSTRUCTION
MANUAL**

ONO SOKKI CO., LTD.

627-9708

CF-300 Portable FFT Analyzer Options

Instruction Manual

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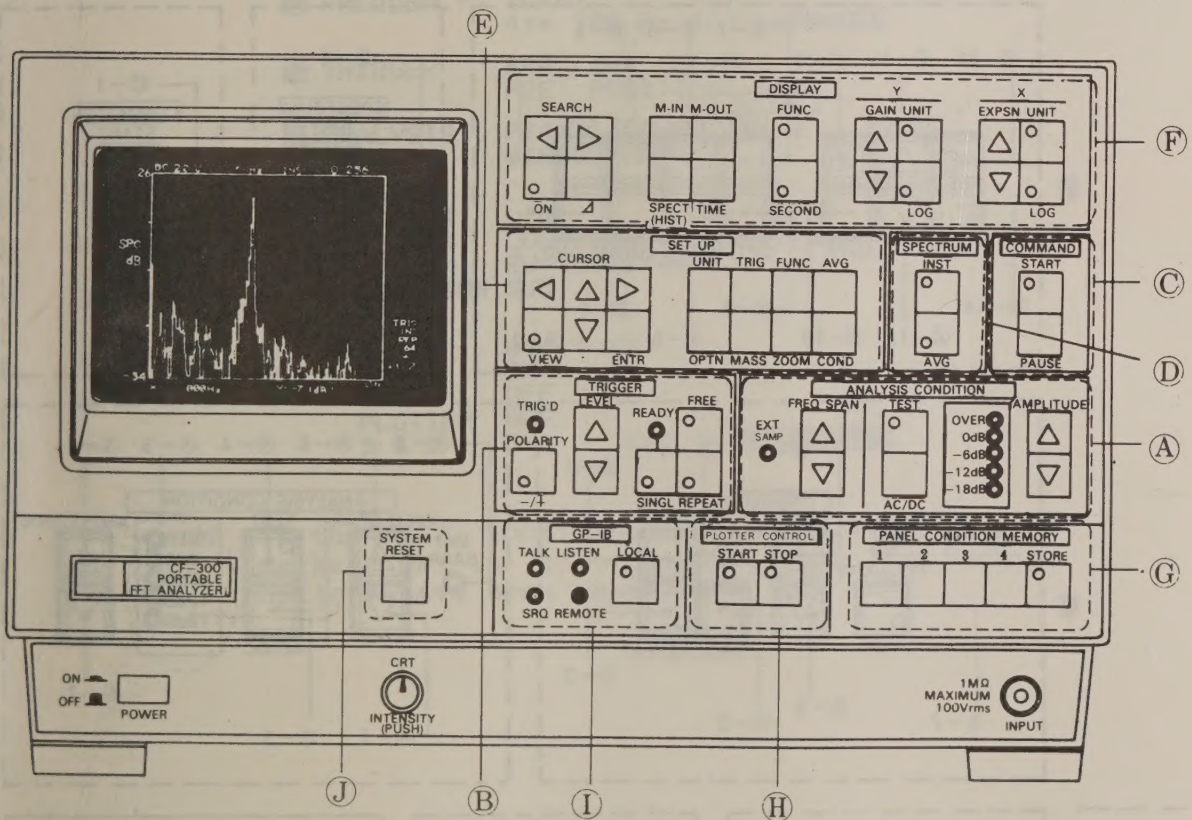
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(The CF-033 GP-IB Package is covered in a separate volume)

We would like to express our appreciation for your purchase of the CF-300 Portable FFT Analyzer.

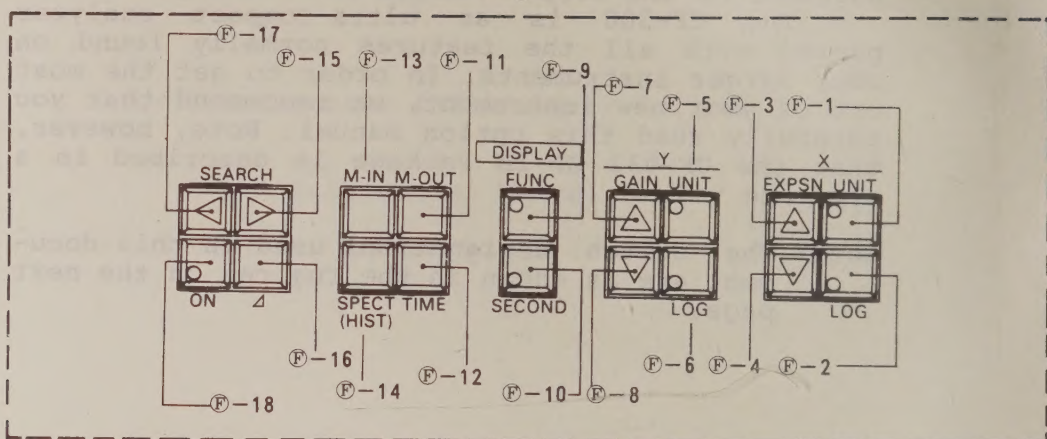
The CF-300 is an ultra-compact analyzer packed with all the features normally found on much larger instruments. In order to get the most out of your new instrument, we recommend that you carefully read this option manual. Note, however, that the CF-032 GP-IB Package is described in a separate volume.

Note: The switch designations used in this document are as shown in the figures on the next page.

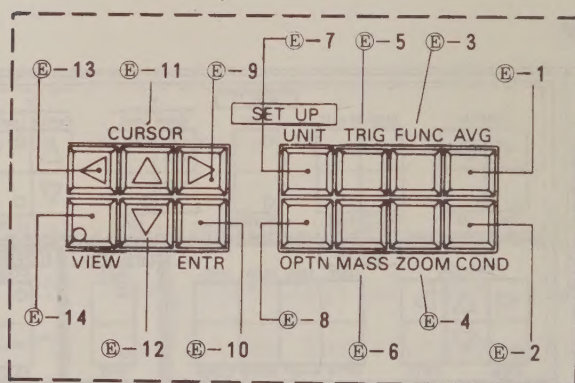


Switch Groups A thru J.

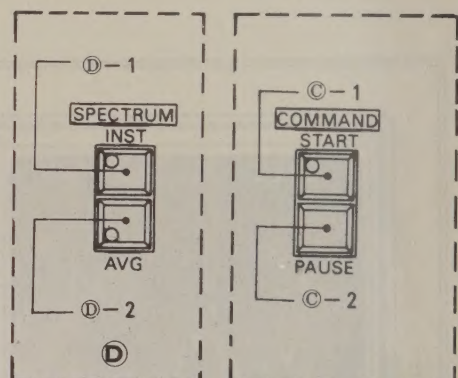
(F)



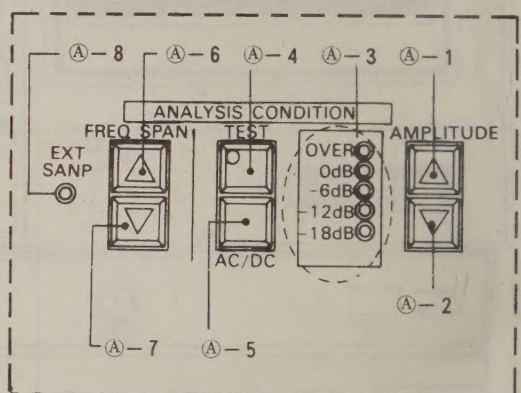
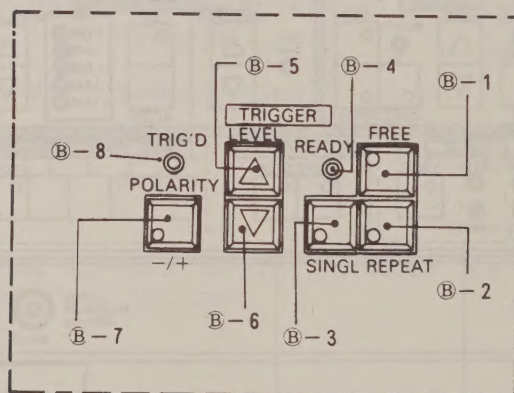
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(D)



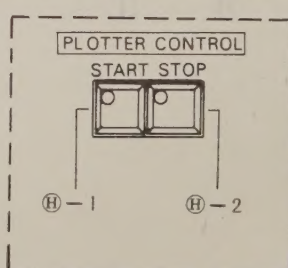
(B)



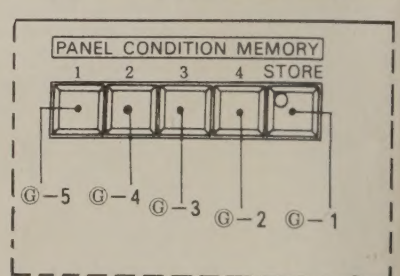
(J)



(I)



(H)



(G)

in the CF-300.

Display	Meaning
6 OPTION	
MASS	CF-031 Mass Memory Card option
ZOOM	CF-032 Real Time Digital Zoom Card option
PLOTTER	CF-034 XY-Plotter Interface Package option
I&D	CF-035 Differentiation and Integration Package option
ON	Above option(s) installed
OFF	Above option(s) not installed

Note that from the display example shown above, it is clear that the CF-031 Mass Memory Card option and CF-035 software package have been installed. This display does not indicate the installation (or non-installation) of the CF-036 and CF-037 options.

CF-031 Mass Memory Card Option

Instruction Manual

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INTRODUCTION

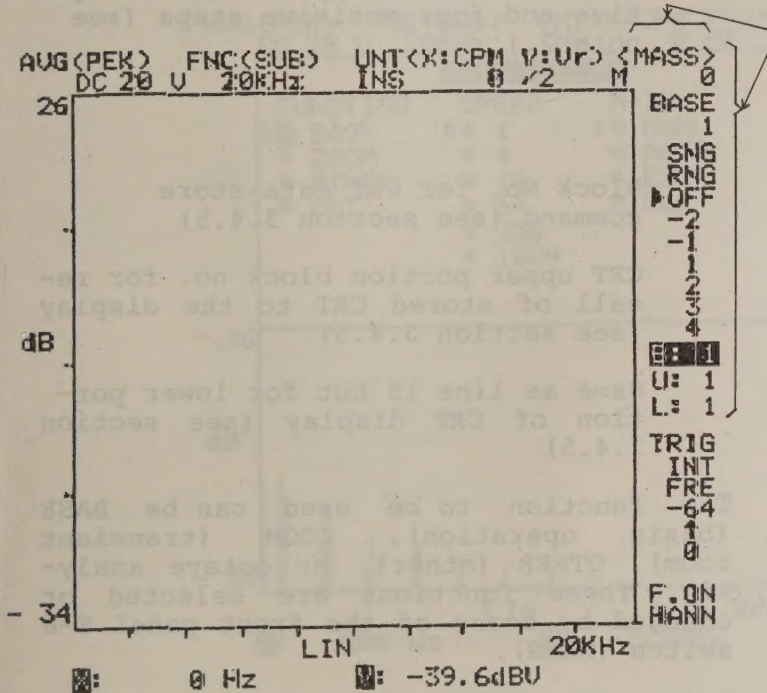
By exchanging the CF-300 Portable FFT Analyzer CPU card, the CF-031 Mass Memory Card option offers the following added features to the CF-300.

- * 32K words of time data storage and frequency analysis.
- * Continuous or separate storage of up to 32 blocks of CRT data as well as three-dimensional display of each 24 blocks (when spectral data has been stored).
- * 36-Line 1/3 octave CRT display.
(With the exception of the two lowest frequency lines, this display conforms to the 34-line ANSI Class III display standards.)
In the 20kHz range, display of 20kHz with a center frequency of 6.3Hz.
(The portion from 10Hz to 20kHz conforms to ANSI Class III display standards.)
In the 500Hz range, display of 500Hz with a center frequency of 0.16Hz
(The portion from 0.25Hz to 500Hz conforms to ANSI Class III display standards.)
- * 12-Line full octave CRT display.
In the 20kHz range, display of up to 16kHz with a center frequency of 8Hz.
In the 500Hz range, display of up to 400Hz with a center frequency of 0.2Hz.
(Switching from the front panel is possible between 1/3 and full octave display modes.)
- * Transient digital zooming of up to 32 times on 32K words of captured time data.
- * Used in combination with the CX-337 Color Plotter, plotting is possible of time records, time traces, and real-time traces. (This requires the installation of the CX-034 Plotter Interface.)

2. CRT ANNOTATION

2.1 Initialization

The initialized state display from a CF-300 which has been fitted with the Mass Memory Option is as shown below.



The 16 lines under the word "MASS" indicate information about the mass memory.

The meanings of these lines are given below.
Display Meaning

Line	Display	meaning
1	M(A, E)	CRT data storage mode (M=manual, A=continuous, E=external)
2	ϕ	Contents of M-IN
3	BASE	Address of stored time axis data (see section 3.1)
4	1	Mass memory function display (see note 1.)
5	SNG	Stored time axis data recall speed display (see note 2.)
6	RNG	Time axis signal 32K word read command (see section 3.1.3)
		Time axis signal continuous read command (see section 3.1.3)

7	OFF	Mass memory time axis storage function cancelling command
8	-2	} Commands to change the stored time axis data recall speed in two negative and four positive steps (see note 2.)
9	-1	
10	1	
11	2	
12	3	
13	4	
14	B:1	Block No. for CRT data store command (see section 3.4.5)
15	U:1	CRT upper portion block no. for recall of stored CRT to the display (see section 3.4.5)
16	L:1	Same as line 15 but for lower portion of CRT display (see section 3.4.5)

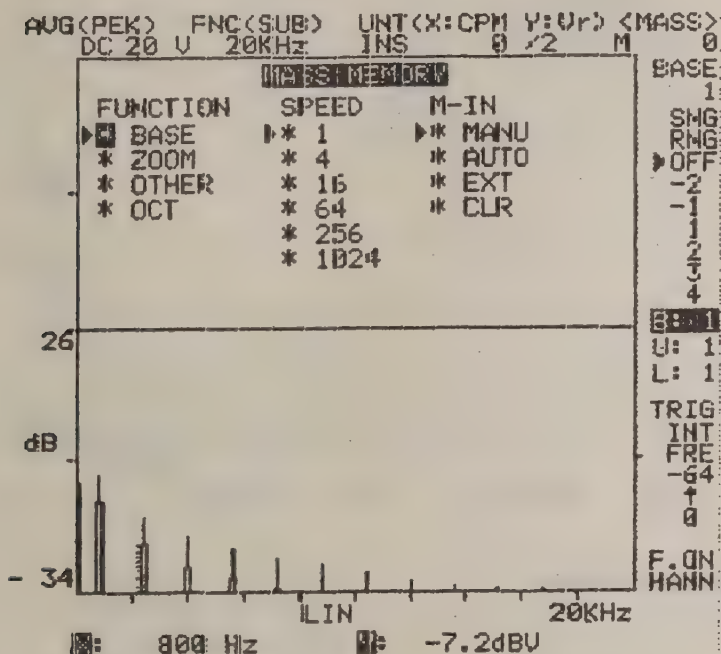
Note 1. The function to be used can be BASE (basic operation), ZOOM (transient zoom), OTHER (other), or octave analysis. These functions are selected or changed by means of the front panel E-6 switch (MASS).

2. The recall speed indicated by line 4 of the display described above indicates the number of points to be shifted when updating (refreshing) the 200-point CRT display of time axis data. For example, of the 32K words, after displaying words 1 thru 200, approximately 0.25s later words 2 thru 201 may be displayed, and do on, continuously shifting in this manner. By using the speeds indicated from line 8 to line 13 above, the overlap can be multiplied by either 1 to 4 or -1 and -2.

2.2 Setting of Mass Memory Conditions

Of the setting switches on the front panel, the ⑥-6 MASS MEMORY and ④-4 ZOOM switches are used to set mass memory conditions.

First, press the ⑥-6 switch. The mass memory setup conditions will be displayed on the CRT as shown below.

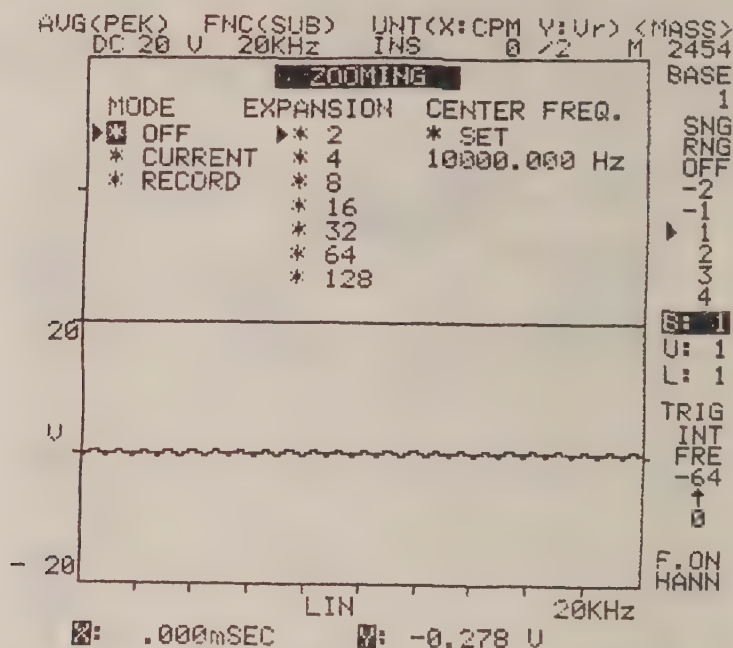


Display Description

Function	Time axis data recall speed	CRT Data memory mode
* Basic operation	* 1 point	* Manual input
* Transient zoom	* 4	* Continuous input
* Other (see note)	* 16	* External command input
* 1/3, 1/1 octave	* 64	* Data clear
	* 256	
	* 1024	

Note: The OTHER indication in the function display refers to such functions as the continuous plotting of 8192 points of data stored in mass memory using the CX-337 Color Plotter with the plotter interface (option CF-034), and generation of spectrum traces.

Next, press the E-4 switch. The CRT will show the following display of digital zoom related data, used to set conditions for that function.



Display Meaning

Mode	Expansion ratio	Center Frequency
* Off operation	*x2	* Set
* CURRENT (real-time zoom)	*x4 *x8	10000.000Hz
* RECORD (transient zoom)	*x16 *x32 *x64 *x128	

Note: Using the CF-031 the RECORD ZOOM mode may be set for up to x32 zooming (transient zoom). If the CF-032 Real Time Zoom Card is not installed, the zoom mode is possible only up to 32 times and settings of x64 or x128 will be ignored by the CF-300 automatically.

3. OPERATION

3.1 32K Word Time Axis Storage

This section will describe the procedure to follow for capture of the time axis signal (up to 32K words may be stored in memory).

3.1.1 Perform the procedure on page of the CF-300 short form operation manual up through step 13. This will complete the setting of input conditions. In this condition, the sampling rate is 2.56 times the set frequency range.

3.1.2 Using switch C-2, put the system into the PAUSE mode.

3.1.3 The time axis 32K word capture method is set using the information at the right side of the CRT display. Two possible methods are available for selection.

(a) SNG (Single)

In this mode, the system is automatically stopped after capture of 32K words of time axis data, initiated either by pressing the C-1 START switch (TRIGGER FREE mode), or upon the occurrence of the trigger after arming the system using the C-1 switch (when using the TRIGGER function).

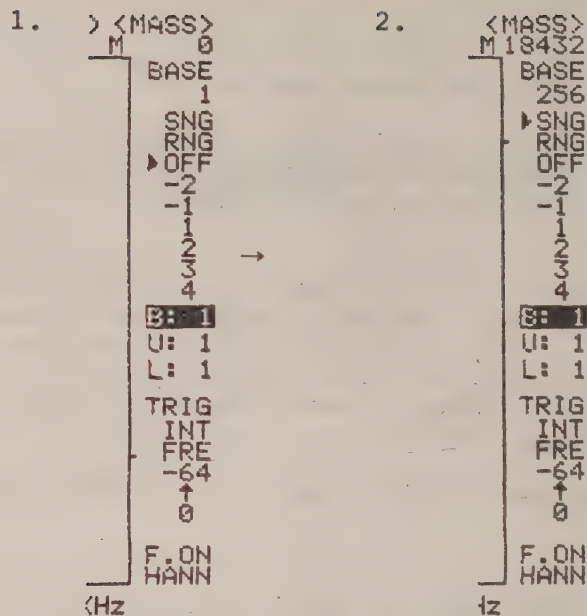
(b) RNG (Ring)

In this mode, while the capture start conditions are the same as in the SINGLE mode, until the PAUSE switch C-2 is pressed or until the EXT MASS STORE pulse is received, time data capture continuously proceeds, the new data replacing old data, so that the memory forms a ring.

This method of capture makes it possible to store in memory the 32K words of time axis data occurring just before the PAUSE C-2 switch is pressed.

3.1.4 Selecting the SNG or RNG Modes

(a) Selecting the SNG Mode



- 1) The arrow mark will be positioned at the OFF if the PAUSE mode is enabled (i.e., if C-2 has been pressed).
- 2) Press E-11 to move the arrow mark to SNG. This completes the selection of the SNG mode, it not being necessary to press the E-10 ENTER switch to record this selection.

(b) To select the RNG mode, perform the above procedure, except that the arrow mark is moved to the left of the RNG line.

3.1.5 When the C-1 COMMAND switch is pressed, the time axis signal is captured and stored in mass memory. In the SNG mode, the system will automatically stop the data capture procedure. However, in the RNG mode the capture procedure will proceed continuously until switch C-2 is pressed.

Note 1. In the procedure step of section 3.1.4, setting is not possible if the E-1 thru E-8 setup menu is displayed on the CRT screen. If it is displayed, press either the F-12 or F-14 display switch.

2. The sampling rates and data lengths for the various frequency ranges are as shown in the following table.

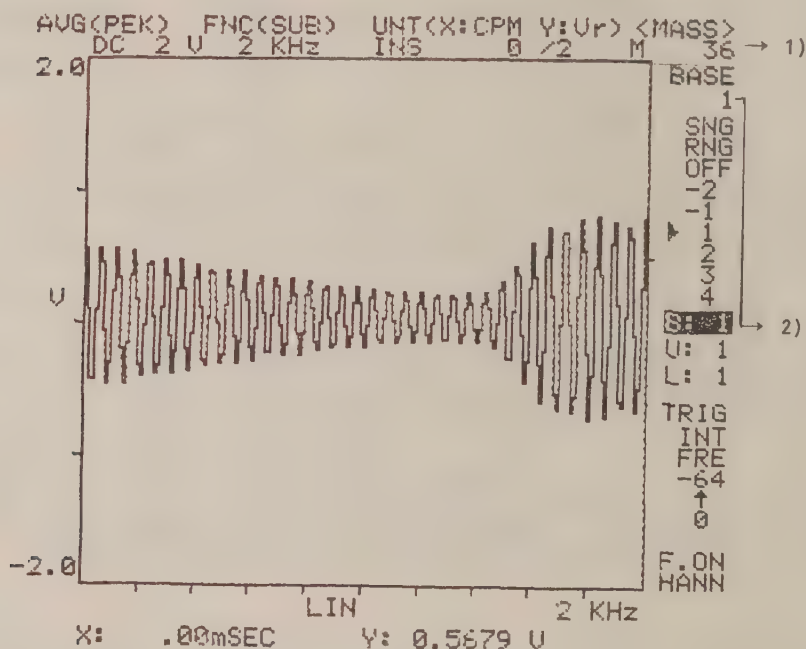
FREQUENCY RANGE	SAMPLING FREQUENCY	CRT DISPLAYED TIME	OVERALL 32K WORD DATA FRAME	SAMPLING PERIOD
20 KHz	51.2 KHz	390.6 mS	0.64 S	19.53 μ S
10 KHz	25.6 KHz	78.12 mS	1.28 S	39.06 μ S
5 KHz	12.8 KHz	156.2 mS	2.56 S	78.12 μ S
2 KHz	5.12 KHz	390.6 mS	6.4 S	195.3 μ S
1 KHz	2.56 KHz	78.12 mS	12.8 S	390.6 μ S
500 Hz	1.28 KHz	156.2 mS	25.6 S	781.2 μ S
200 Hz	51.2 Hz	390.6 mS	64.0 S	1953 μ S
100 Hz	25.6 Hz	0.781 S	128.0 S	3906 mS
50 Hz	12.8 Hz	1.562 S	256.0 S	7812 mS
20 Hz	5.12 Hz	390.6 S	640 S	1953 mS
10 Hz	2.56 Hz	78.12 S	1280 S	3906 mS
5 Hz	1.28 Hz	156.2 S	2560 S	78.12 mS
2 Hz	5.12 Hz	390.6 S	6400 S	195.3 mS
1 Hz	2.56 Hz	78.12 S	12800 S	390.6 mS

3.2 Recalling a Stored Time Axis Data Set

This section will describe the procedure to follow for recalling a stored time axis data set to the CRT display.

- 3.2.1 Enable the START mode by pressing switch C-1. 200 words of captured time axis data will be displayed on the CRT and refreshed approximately every 0.2s. Next, press the C-2 switch to place the CF-300 in the PAUSE mode (if it was in the time-axis display mode).

The CRT display will appear as shown in the example display below.



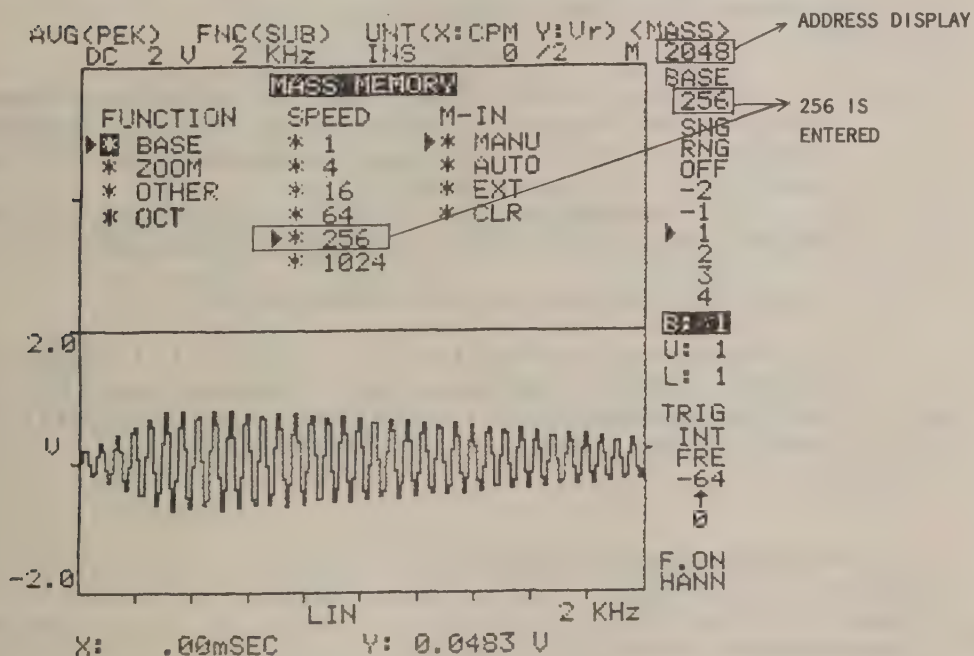
- 1) This number indicates that the left side of the CRT display is the 36th word of the 32K words captured.
- 2) This number indicates the amount of data shift between updates (refreshes). In this case, the data is shifted 1 point for each subsequent refresh. Refer to section 3.2.3 for the method of changing this shift.

- 3.2.2 Press the START switch C-1 once more. Again the CRT will start displaying data from address 0 in

sequence. Or, if the D-1 or D-2 switches are pressed, the currently stored data in memory is analyzed.

Next, use the E-11 and E-12 switches to move the cursor (arrow mark) up and down to the speed indications at the right side of the CRT display. With the arrow set to the 2, the amount of shift in time axis between refreshes is multiplied by 2. Multiplication of 3 or 4 times is also settable. Note that if -1 or -2 is selected the addresses decrement.

- 3.2.3 To make a large change in the amount of data shift between refreshes, press the E-6 setup MASS memory switch and then modify SPEED, recording the change by using the E-10 ENTER switch. The example of multiplying the data shift by 256 and entering this change is shown in the figure below.



The multiplication procedure described in Section 3.2.2 is operable on the number stored in this manner as well. The settable range is from 1 point to 4096 points, and 200 words may be displayed on the CRT starting at any address in the 32K word memory. Also CRT annotation indicates at what address the 200-word display starts, this data being displayed as the 2nd line or right side annotation display.

Note that the data set here as the data shift becomes the data spacing for the continuous spectrum analysis performed by the procedure described in Section 3.3

3.3 Performing Frequency Analysis On a Stored Time Axis Data Set

3.3.1 Following the procedure in Section 3.2, recall a stored time axis data set to the CRT display.

Verify that the 3rd line of the annotation display to the right side of the CRT screen is BASE.

3.3.2 Press the F-10 SECOND switch. This causes the displayed time axis signal to shift to the lower part of the CRT screen.

3.3.3 Press the F-14 SPECT switch. This sets the frequency analysis range for the displayed time axis data as the 512 points starting at the address indicated 2nd line of the CRT right portion annotation display.

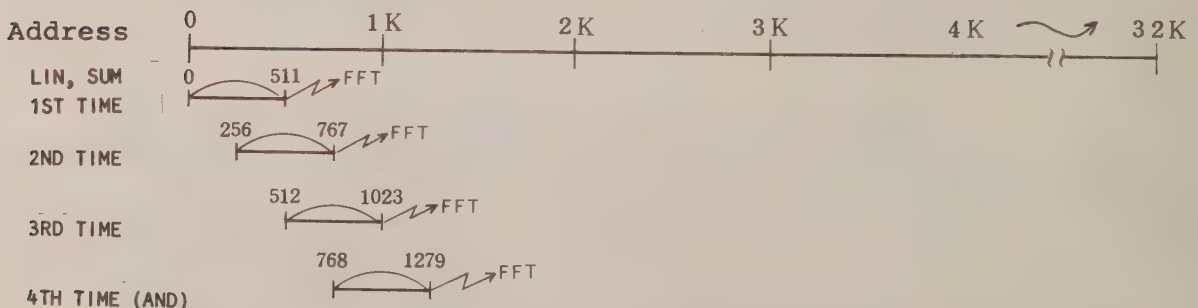
3.3.4 If averaging of the spectrum is to be performed, record the averaging mode using the E-1 switch. The D-2 switch may be used to execute any of the available averaging modes.

The window overlap for this analysis will be as set using SPEED as described in Section 3.2.2.

Example: Use E-6 to set SPEED to 256.

If the speed multiplier is 1 and E-1 is used to select LINEAR averaging of 4 times and this is recorded, when D-2 is pressed, the data will be analyzed as shown in the figure below.

Stored time axis data



The analysis will be performed as shown above with the window applied to the time axis data. Using the procedure described in Sections 3.2.2 and 3.2.3, the amount of shift in data can be modified greatly.

3.3.5 All modes, including transformation of the vertical and horizontal display modes are possible after display of the analyzed spectrum.

Note 1. While time axis averaging is possible, since no trigger function is used, this type of execution is significant only when using an externally provided sampling clock.

2. It is possible to produce a three-dimensional display of the spectral data resulting of the analysis of stored time-axis signals. The analysis procedure starts with the procedures described in sections 3.3.1 thru 3.3.3 and is followed by the use of the FUNC button E-3, selection of ARRAY, RECORDING, and finally execution by using the FUNC pushbutton F-9.

The spacing interval between spectra for the three-dimensional display is determined by the SPEED set according to the sections 3.2.2 and 3.3.3.

3.4 Using the Transient Digital Zoom Function

This section will describe the procedure for processing the 32K words of data captured as described in Section 3.1 to enable transient zooming by means of digital filtering.

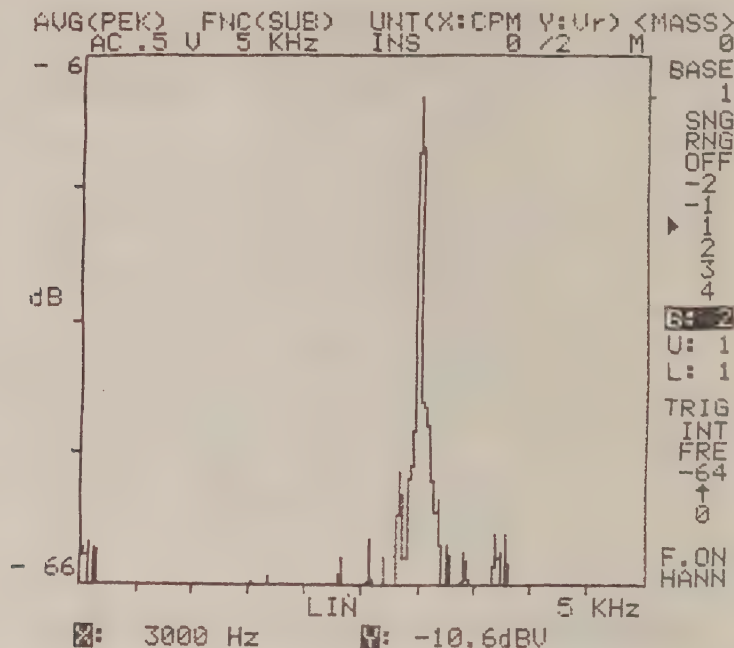
3.4.1 Following the procedure described in Section 3.1, store time axis data in mass memory. Note that when doing this, the frequency range setting will affect the frequency resolution after zooming is executed.

Example: In the 20kHz range, the baseband spectrum from which a resolution of 100Hz (200 line up to 20kHz) can be zoomed 2, 4, 8, 16 or 32 times to yield a resolution of 50Hz, 25Hz, 12.5Hz, 6.25Hz, or 3.125Hz respectively.

In the same manner, for the 2kHz range the 10Hz resolution can be expanded from 2 to 32 times for a maximum resolution of 0.3125Hz. Zooming between set frequency ranges is also possible.

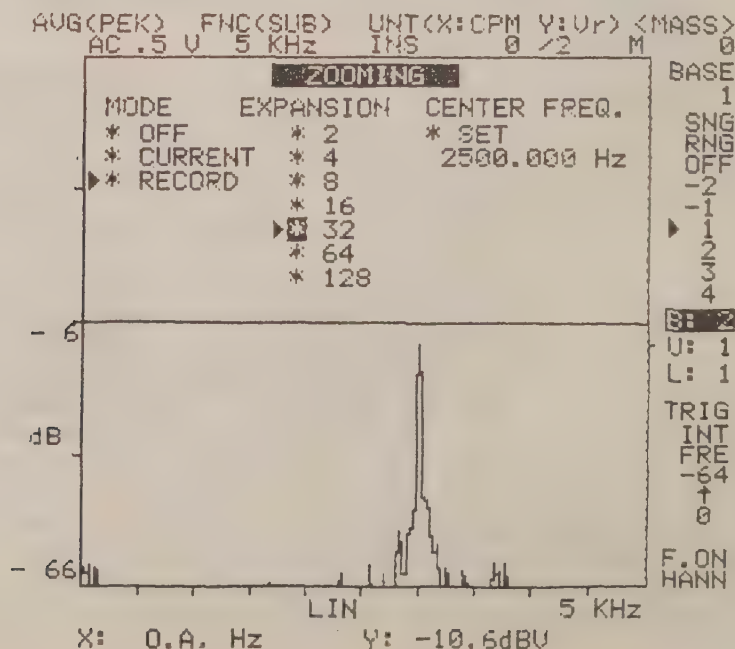
If the RNG mode had been selected, use the C-2 PAUSE switch to stop the data capture process.

- 3.4.2 Press switch F-14 to display the spectrum on the CRT. This is the original, baseband spectrum, which will be expanded.



This example shows the 5kHz baseband spectrum obtained from an analysis of the 3kHz playback signal from a cassette tape recorder.

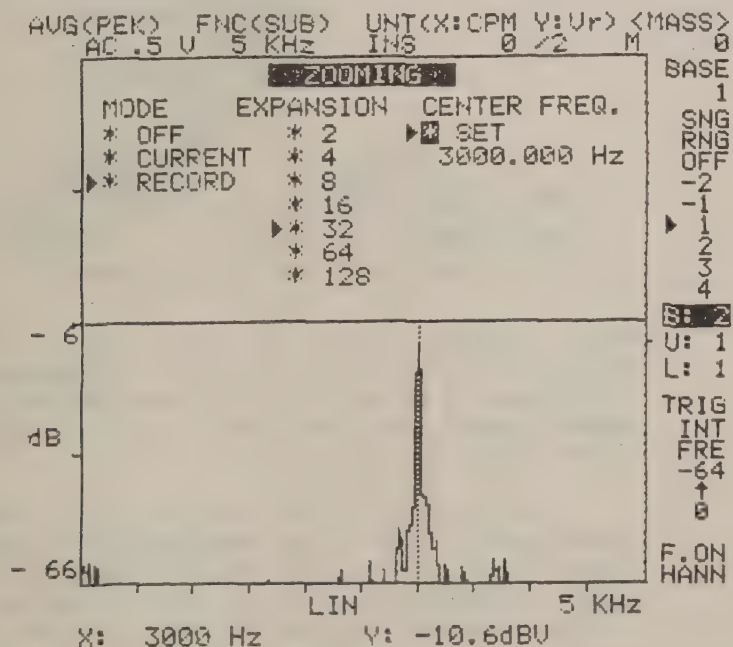
- 3.4.3 Press the ZOOM switch E-4, and use the switches E-9 thru E-13 to jog the cursor (arrow mark) to the RECORD position of the ZOOMING menu, recording this selection, as well as the setting of the expansion ratio.



This example shows the selection of the RECORD mode (transient zooming). EXPANSION is set to 32 times. The center frequency of 2500.000Hz is recorded.

3.4.4 In the same manner, the center frequency about which zooming is to be performed is determined and selected.

- (a) Use F-18 to turn the SEARCH function ON.
- (b) Use switches F-17 and F-15 to jog the cursor to the spectrum peak or other area that you wish to expand using the ZOOM function (if the SEARCH function is OFF, the maximum value will be automatically used as the center frequency).
- (c) Use switch E-9 to bring the mark to the left of the annotation CENTER FREQ. SET.
- (d) Press E-10 to record the setting. This completes the setting of the center frequency for zooming.

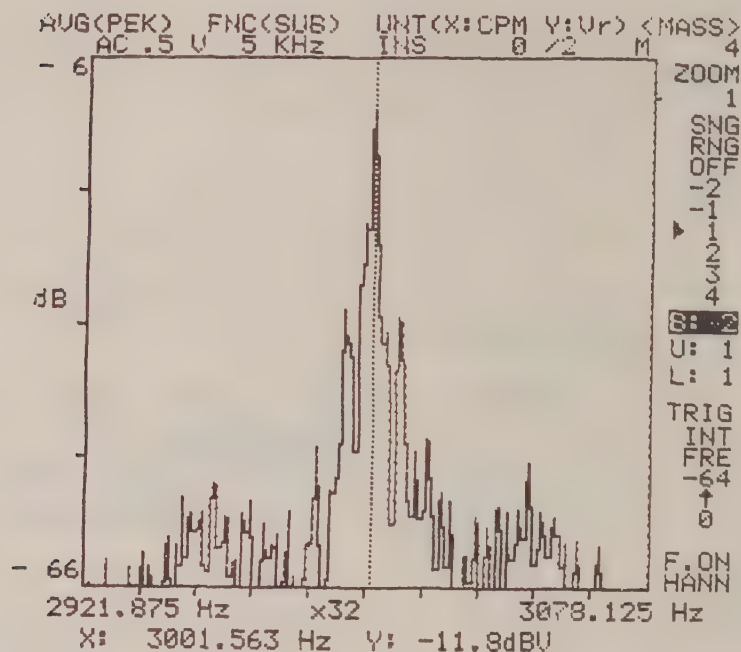


This shows the example of the center frequency set to 3KHz.

3.4.5 Press the C-1 START switch. This will cause a transient digital zoom to be executed with the set center frequency.

The time required for zooming with various expansion magnifications is as follows.

x2 Magnification	Approx. 1.25s/execution
x4 Magnification	Approx. 2.1s/execution
x8 Magnification	Approx. 3.1s/execution
x16 Magnification	Approx. 5.5s/execution
x32 Magnification	Approx. 9.8s/execution



The example above is that of a 32 times zoom performed at about a center frequency of 3kHz. A 200-line display with a resolution of 0.78Hz is shown over the 156.25Hz span from 2921.875Hz to 3078.125Hz.

Note that if the E-1 switch is used to select peak hold, linear, or exponential averaging, it is possible to average while zooming. The spectrum after zooming can not be expressed in terms of LOG or EXP scaled horizontal axis values. However, the vertical axis units may be changed.

- Note 1. The zoomed frequency range and resolution for the various frequency ranges and zoom expansion ratios are given in the following table.
2. The relationship between the expansion ration used for zooming and the length of the time axis signal frame is the zoom expansion ratio x 512 points. For example, with an expansion ratio of x4, 4 x 512 words (2048 words) or for a ratio of x32, 32 x 512 words (16K words) would be the time axis data length of the sample used. When averaging as well as zooming, the overlap between subsequent frames of data (data shift) is the same as described in the example given in Section 3.3.4.

Therefore, when selecting a high expansion ration, to avoid duplication due to overlapping, the E-6 switch should be used to set the speed as high as possible.

When using averaging at a high expansion ratio, the PAUSE mode is entered automatically when the entire 32K words of memory space has been resampled.

Table 1 Relationship of Selected Frequency Range to Zoom Frequency Range With Various Zooming Ratios

RATIO FREQ. RANGE	X 1 (BASE)		X 2		X 4		X 8		X 16		X 32	
	FREQ. RANGE	RESOLU- TION	FREQ. RANGE	RESOLU- TION	FREQ. RANGE	RESOLU- TION	FREQ. RANGE	RESOLU- TION	FREQ. RANGE	RESOLU- TION	FREQ. RANGE	RESOLU- TION
20 K Hz	20 KHz	100 Hz	10 KHz	50 Hz	5 KHz	25 Hz	2.5 KHz	125 Hz	1.25 KHz	625 Hz	625 Hz	3125 Hz
10 K Hz	10 KHz	50 Hz	5 KHz	25 Hz	2.5 KHz	125 Hz	1.25 KHz	625 Hz	625 Hz	3125 Hz	3125 Hz	15625 Hz
5 K Hz	5 KHz	25 Hz	2.5 KHz	125 Hz	1.25 KHz	625 Hz	625 Hz	3125 Hz	3125 Hz	15625 Hz	15625 Hz	07825 Hz
2 K Hz	2 KHz	10 Hz	1 KHz	5 Hz	500 Hz	25 Hz	250 Hz	125 Hz	125 Hz	625 Hz	625 Hz	03125 Hz
1 K Hz	1 KHz	5 Hz	500 Hz	25 Hz	250 Hz	125 Hz	125 Hz	625 Hz	625 Hz	3125 Hz	3125 Hz	015625 Hz
500 Hz	500 Hz	25 Hz	250 Hz	125 Hz	125 Hz	625 Hz	625 Hz	3125 Hz	3125 Hz	15625 Hz	15625 Hz	0078125 Hz
200 Hz	200 Hz	1 Hz	100 Hz	0.5 Hz	50 Hz	0.25 Hz	25 Hz	0.125 Hz	125 Hz	00625 Hz	625 Hz	312 mHz
100 Hz	100 Hz	0.5 Hz	50 Hz	0.25 Hz	25 Hz	0.125 Hz	125 Hz	0.0625 Hz	625 Hz	3125 mHz	3125 Hz	15625 mHz
50 Hz	50 Hz	0.25 Hz	25 Hz	0.125 Hz	125 Hz	0.0625 Hz	625 Hz	0.03125 Hz	3125 Hz	15625 mHz	15625 Hz	78125 mHz
20 Hz	20 Hz	0.1 Hz	10 Hz	0.05 Hz	5 Hz	0.025 Hz	2.5 Hz	0.0125 Hz	1.5625 Hz	78125 mHz	0625 Hz	3125 mHz
10 Hz	10 Hz	0.05 Hz	5 Hz	0.025 Hz	2.5 Hz	0.0125 Hz	1.25 Hz	0.00625 Hz	0.78125 Hz	3125 mHz	03125 Hz	15625 mHz
5 Hz	5 Hz	0.025 Hz	2.5 Hz	0.0125 Hz	1.25 Hz	0.00625 Hz	0.625 Hz	0.003125 Hz	0.3125 Hz	15625 mHz	015625 Hz	078125 mHz
2 Hz	2 Hz	0.01 Hz	1 Hz	0.005 Hz	0.5 Hz	0.0025 Hz	0.25 Hz	0.00125 Hz	0.15625 Hz	0.78125 mHz	00625 Hz	03125 mHz
1 Hz	1 Hz	0.005 Hz	0.5 Hz	0.0025 Hz	0.25 Hz	0.00125 Hz	0.125 Hz	0.000525 Hz	0.78125 Hz	03125 mHz	003125 Hz	015625 mHz

To return the CF-300 from the mass memory type of operation to the normal 512 point input, 200-line FFT mode, perform the following procedure, described in Section 3.4.6 through 3.4.9.

- 3.4.6 Enable the system PAUSE mode using the C-2 switch. Use E-11 and E-12 to move the arrow mark to the left of the OFF line on the CRT screen annotation section. This turns the mass memory function OFF.
- 3.4.7 Once again press the C-1 START to execute in the normal mode and perform analysis on input data.
- 3.4.8 It is possible to once again use the 32K words of data stored in mass memory. To do this, in the PAUSE mode move the arrow mark to the 1, 2, 3, or 4 of the CRT annotation display and use the C-1 to enable the START condition once more. This causes an analysis of the contents of mass memory to be executed.
- 3.4.9 To store a new set of data in the 32K word memory, perform the procedure of Section 3.1 to clear the mass memory contents and record new data.

3.5 Storing CRT Data

This section will describe the procedure to follow for storing CRT data in the mass memory in up to 32 blocks.

- 3.5.1 Press the E-6 switch and set the M-IN (Manual Input) condition. In the initialized state (every time F-13 is pressed) M-IN is selected.

In addition, AUTO (continuous input, EXT (external command input) and CLR (data clear) input as appropriate.

When selecting EXT, a TTL-level signal is applied to the BNC connector provided for this purpose at the CF-300 rear panel to initiate storage of data in the mass memory (for details, see the CF-300 Instruction Manual).

- 3.5.2 Display the data you wish to store on the CRT screen. At this time, press the C-1 COMMAND START of D-1/D-2 switches to exit from the setup condition.

3.5.3 Press F-13 to store data in memory (M-IN). If in Section 3.5.1 manual input is selected, regardless of the operation and setting of the START/PAUSE, the CRT displayed data will be stored every time the F-13 switch is pressed. If the AUTO mode has been selected, in the system START condition, when the F-13 switch is pressed, 32 blocks of CRT data are automatically and continuously stored in memory. If, for this type of storage, the E-1 LIN averaging mode was selected and D-2 used to execute this averaging, and the F-13 switch is pressed before the set number of averages is completed, every time data will be stored in mass memory every time the set number of averages has been completed. When the CRT dual display mode is being used, one storage will use two blocks of the 32 block capacity.

3.5.4 If the storage is performed as described in Section 3.5.3 and the 3rd block had been stored, the 13th line of the CRT annotation section will be displayed as B:3.

For example, if in the initialized state or whenever the E-6 M-IN has been selected, the memory will clear and B:1 will be displayed in reversed characters. If the characters are not reversed, it means that CRT has already been stored. Also, with M-IN selected, up to 32 blocks (B:32) of storage is possible.

3.6 Recalling Stored CRT Data

3.6.1 Use E-13 and E-14 switches to recall the number of the block you wish to recall to the 13th line of the CRT annotation display.

For example, to recall the 13th block, press E-14 until B:13 is displayed.

3.6.2 Press F-11 (M-OUT). This will cause block number 13 to be recalled and displayed on the CRT screen. At this time, the 15th line of the CRT annotation display will show L:13, indicating the block number of a single display or the lower portion of a dual display.

3.6.3 Displaying Two Blocks Simultaneously

If, for example, you wish to display blocks 13 and 5 simultaneously, press the F-10 SECOND switch, upon which the block 13 data will shift to the lower portion of the display. Next, in the same manner as for the selection of block 13 described above, press switch E-13 until the annotation display reads B:5, after which M-OUT is pressed to bring block 5 to the upper portion of the CRT display. At this time, the 14th line of the CRT annotation display will show U:5, indicating the block number of the data displayed in the upper portion of a dual display.

- 3.6.4 At this point, SUB, ADD, DIN, and MULT operations on the upper display data by the lower display data are selectable using the E-3 FUNCTION selection and executable using switch F-9. (For details, refer to the CF-300 Instruction Manual).

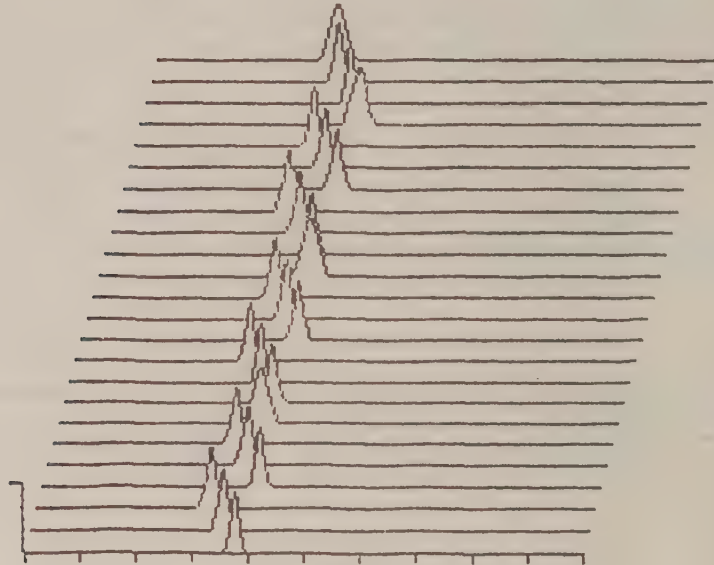
3.7 Three-Dimensional Plotting of Stored Data

It is possible to plot three-dimensionally on the CRT spectral data stored in mass memory using M-IN. The procedure is as described below.

- 3.7.1 Store the spectra in memory, following the procedure described in Section 3.5.
- 3.7.2 Press E-3 to select the function.
- 3.7.3 Use switches E-9 thru E-13 to select ARRAY (MASS) and record using E-10.
- 3.7.4 Start the system using the C-1 switch.
- 3.7.5 Set the first block to be used for the three-dimensional display by using E-13 and E-14 switches in the manner described in Section 3.6.1. For example, if the 5th block is to be the starting block for the three-dimensional display, the selection is made so that the 13th line of the CRT annotation display reads B:5.

- 3.7.6 Using switch F-9, execute the ARRAY (MASS) function. This causes the 24 blocks starting at the block selected in the step described in Section 3.7.5 to be plotted on the CRT in three-dimensional form. If the F-9 switch is pressed once more, the remaining blocks up to the 32nd block are displayed in three-dimensional form.

AUG(SLM) FNC(ARM) UNT(X:CPM Y:Ur)
AC 2 U 2 KHz INS 0 /4 B:28



This example shows the three-dimensional display using the 24 blocks from block 5 to block 28. The B:28 at the right side of the CRT indicates the number of the 24th block used for this display.

3.8 1/3 Octave and 1/1 Octave Analysis

This section will serve to describe the 1/3 octave and 1/1 octave analysis functions usable with the mass memory feature.

Both 1/3 and 1/1 octave analysis can be performed simultaneously. 36 Bands are simultaneously analyzed in the 1/3 octave analysis mode (refer to the table in this section).

The bands for 1/3 and 1/1 octave analysis are defined in terms of the center frequency and cutoff frequencies as shown below. If the center frequency is f_{oi} and the cutoff frequencies are f_{ci-1} , f_{ci-2} , the relationships are:

$$f_{oi} = f_{ci-1} \cdot f_{ci}$$

$$f_{ci} = f_{ci-1} \times 2^{1/n}$$

$$f_{oi+1} = f_{oi} \times 2^{1/n}$$

Where $n = 1$ for 1/1 octave analysis and $n = 1/3$ for 1/3 octave analysis.

The internationally recognized standards for center frequencies and cutoff frequencies is shown in the table in this section. The CF-300 is capable of simultaneous analysis of 36 bands as shown in this table.

As shown in the table, 1/1 octave analysis is performed in the 20kHz, 10kHz, and 5kHz ranges with the center frequency referenced to 1kHz. Care is required as this does not apply to the 2kHz, 1kHz and 500Hz ranges.

The 34 bands above the lowest two frequency bands conform to the ANSI Class III standards for 1/3 octave analysis. 1/1 Octave analysis is derived from the results of 1/3 octave analysis.

The octave analysis procedure is described below.

3.8.1 Using the C-2 switch, place the system in the PAUSE mode. Use E-11 and E-12 to set the arrow marker to the CRT annotation section OFF.

3.8.2 Press the E-6 MASS switch of the SETUP group of switches and FUNCTION to OCT, using the arrow marker on the menu. Record this using the E-10 switch.

3.8.3 Set the frequency range using the table in this section as a guide (20kHz to 500Hz).

Note: For settings below 500Hz, the 20kHz range will automatically be selected as a default. The required analysis time for each frequency range is given in Table II.

3.8.4 PEAK, EXP, LINE, and SUM averaging modes may be selected. For non-averaging, EXP or SUM may be used.

3.8.5 In the INST mode a single processing step is executed, after which the system enters the PAUSE mode automatically.

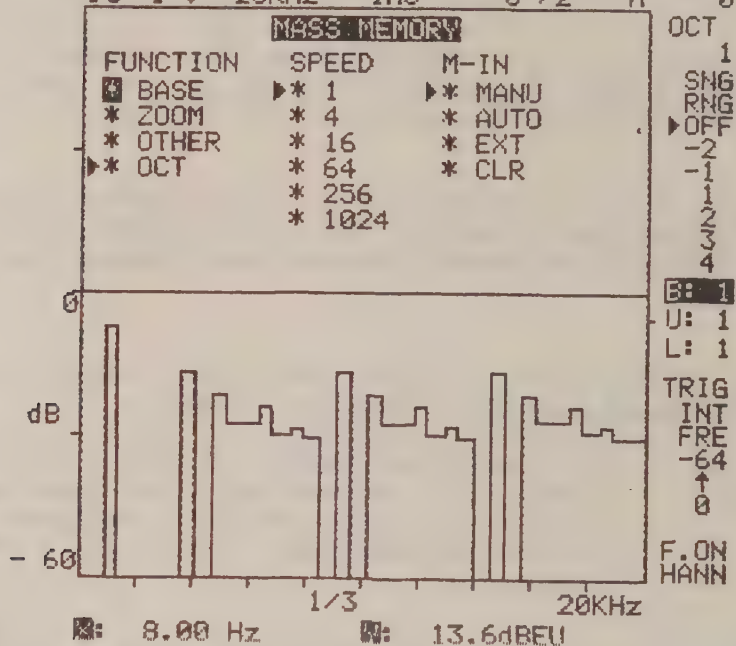
3.8.6 Switching between 1/3 and 1/1 octave analysis is done by means of F-1 X UNIT ON/OFF function. Switching may be done after analysis as well as before starting analysis.

3.8.7 When the C-1 system START is pressed, octave analysis is begun.

1/3 Octave analysis: X-UNIT OFF
1/1 Octave analysis: X-UNIT ON

3.8.8 To return the system from the octave analysis mode to the normal analysis mode, set the function as described in Section 3.8.2 to any function other than OCT.

AUG(PEK) FNC(SUB) UNT(X:CPM Y:EU) <MASS>
 DC 1 V 20KHz INS 0 /2 M 0



(Range) (Setting)		(Center Freq) (Range<Hz>)	(ANSI Std 1/3-oct) (Band Number)	(Time) (Sec)
1/3 OCT	500 Hz	0.16 — 500	(-8)-27	95
	1 kHz	0.315 — 2,000	(-5)-30	46
	2 kHz	0.63 — 2,000	(-2)-33	25
	5 kHz	1.6 — 5,000	2 -37	12
	10 kHz	3.15 — 10,000	5 -40	7
	20 kHz	6.3 — 20,000	8 -43	4.5
1/1 OCT	500 Hz	0.2 — 400	(-7)-26	95
	1 kHz	0.4 — 800	(-4)-29	46
	2 kHz	0.8 — 1,600	(-1)-32	25
	5 kHz	2.0 — 4,000	3 -36	12
	10 kHz	4.0 — 8,000	6 -39	7
	20 kHz	8.0 — 16,000	9 -42	4.5

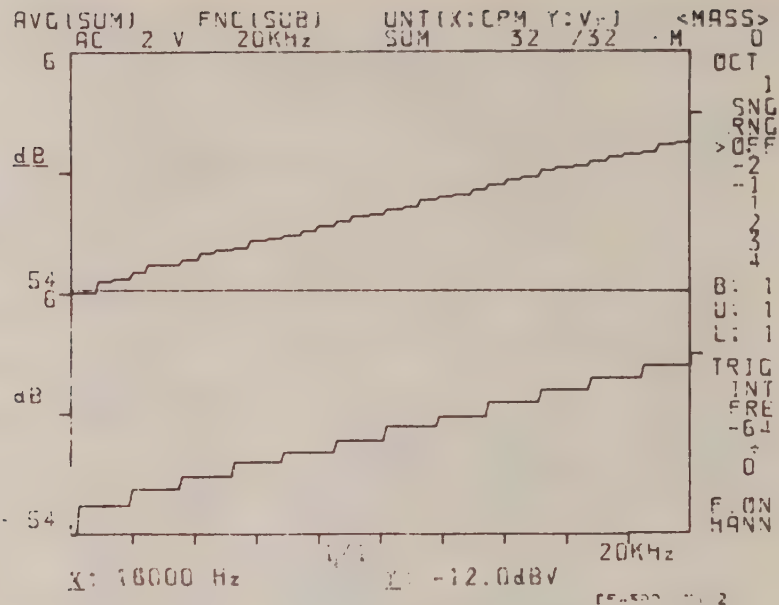
Table II Number of Bands and Analysis Time for Octave Analysis

- Note 1. Switching between 1/3 and 1/1 octave analysis is not possible for mass memory OUT. Therefore, output is in the same mode in effect at the time of writing into memory.
2. In the 1/3 octave mode, the functions SUB, ADD, ARRAY, etc., do not operate.
 3. OVER ALL is the value corresponding to an integration over the entire width of the analysis range. For example, in the 20kHz range, it represents the spectral contents from 6.3Hz to 20kHz.
 4. A Hanning window is always used in either 1/3 or 1/1 octave analysis (even if it appears to have been manually switched OFF).
 5. A narrowband FFT analysis is executed to derive the final fixed-ratio width octave band spectrum as defined by the cutoff frequencies. The cutoff frequencies for this process of the 3dB down points.

To arrange the FFT analyzed data into 36 bands, there are three frequency ranges for which the sampling rate differs. (See the table below.)

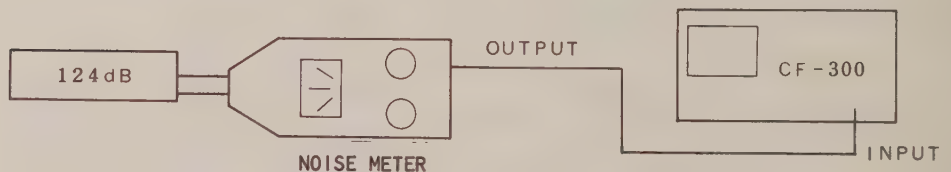
Frequency range	Three sampling frequency ranges
20KHz	(20K, 2K, 200) x 256
10KHz	(10K, 1K, 100) x 256
5KHz	(5K, 500, 50) x 256
2KHz	(2K, 200, 20) x 256
1KHz	(1K, 100, 10) x 256
500Hz	(500, 50, 5) x 256

Therefore, this form of analysis is performed in the TRIG FREE mode. However, in the ON mode, three trigger pulses are required for a single analysis.



1/3 Octave (top and Full Octave Analysis results from a white noise source

Relationship of Noise Meters to Engineering Units (EU) Calibration Method



As shown in the figure above, a pistonphone is inserted into a noise meter and the output of the noise meter is input to the CF-3E, using the EU function to provide direct readings of sound level in dB. The calibration procedure is as follows.

- 1) Calibrate the noise meter using the pistonphone. For this procedure, refer to the instruction manual of the noise meter.
- 2) As shown in the figure, connect the output of the noise meter to the CF-300 input.
- 3) Select the 10kHz frequency range on the CF-300 and linear averaging of eight times. Perform a power spectrum analysis.
- 4) After the C-2 switch goes into the PAUSE mode, use the F-6 switch to set up a linear Y-axis voltage reading (i.e., a linear spectrum).
- 5) Using switches F-18, F-17, and F-15, use the search function to read the value of the overall spectrum at the right side of the CRT display.
- 6) If, at this time, the pistonphone reference sound pressure is, for example, 124dB (this will vary depending upon the manufacturer of the pistonphone), the overall voltage value will correspond to a sound pressure level of 124dB with an attenuator setting of 120dB.
- 7) If this value is set as the voltage value for the EU function on the CF-300, it is possible to read values directly in the field in terms of sound pressure. Caution, however, is required as it is required to read the overall voltage value once again to obtain the true value of sound pressure as the calibration value plus 4dB. That is, if the voltage value in step 6) above was X volts, it is necessary to make the 0dBEU level be this value minus 4dB. Since +4dB corresponds to multiplying the value by 1.5848, the 0dBEU value is calculated as follows.

$$EU = \frac{X}{1.5848} \times 1000 \quad \text{mV/EU}$$

This value is set up as the EU value using switch E-7, whereupon the F-5 switch can be used to directly read sound pressure levels.

$$(1.5848 = 10^{4/20})$$

Note: In general, Even if the attenuator range is changed, if the dB value for the first digit is the same, the same voltage will be output. That is, the 124dB calibration voltage value for the 120dB attenuator range is the same value as that read in the 70dB attenuator range for a 74dB sound value in the field. Thus, using the above method, if the search value is added to the attenuator value used with the noise meter, the actual sound pressure level is obtained.

CF-032 Real Time Digital Zoom Card Option

Instruction Manual

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1. INTRODUCTION AND SPECIFICATIONS

The CF-32 Real Time Digital Zoom Card Option is an option card for the CF-300 analyzer that is installable in an internal slot provided in the CF-300 for this purpose. It enables the expansion about any arbitrary center frequency on each frequency range using an expansion ratio of from x2 to x128.

Specifications

Center frequency setting:	Set by means of the search marker to any arbitrary point.
Center frequency setting resolution:	1/6400 of the frequency range
Dynamic range:	60dB (typical)
Frequency accuracy:	0.005% of the frequency range
Frequency resolution:	1/25600 of the frequency range
Amplitude flatness:	+0.5dB (with respect to the center resolution)
Expansion ratios:	x2, x4, x8, x16, x32, x64, and x128 (7 ranges) as well as ZOOM OFF
No. of display lines:	200
Analyzed data set length:	Refer to Table II

FREQUENCY RANGE (Hz)	FREQUENCY RESOLUTION							
	× 1 (OFF)	× 2	× 4	× 8	× 16	× 32	× 64	× 128
1 Hz	5 mHz	2.5 mHz	1.25 mHz	0.625 mHz	0.3125 mHz	0.5625 mHz	78.125 μ Hz	39.0625 μ Hz
2	10 mHz	5 mHz	2.5 mHz	1.25 mHz	0.625 mHz	0.3125 mHz	0.15625 mHz	78.125 μ Hz
5	25 mHz	12.5 mHz	6.25 mHz	3.125 mHz	1.5625 mHz	0.78125 mHz	0.390625 mHz	195.3125 μ Hz
10	50 mHz	25 mHz	12.5 mHz	6.25 mHz	3.125 mHz	1.5625 mHz	0.78125 mHz	0.390625 mHz
20	0.1 Hz	50 mHz	25 mHz	12.5 mHz	6.25 mHz	3.125 mHz	1.5625 mHz	0.78125 mHz
50	0.25 Hz	125 Hz	62.5 mHz	31.25 mHz	15.625 mHz	7.8125 mHz	3.90625 mHz	1.953125 mHz
100	0.5 Hz	0.25 Hz	0.125 Hz	62.5 mHz	31.25 mHz	15.625 mHz	7.8125 mHz	3.90625 mHz
200	1 Hz	5 Hz	0.25 Hz	0.125 Hz	62.5 mHz	31.25 mHz	15.625 mHz	7.8125 mHz
500	2.5 Hz	1.25 Hz	0.625 Hz	0.3125 Hz	0.15625 Hz	78.125 mHz	39.0625 mHz	19.53125 mHz
1 k	5 Hz	2.5 Hz	1.25 Hz	0.625 Hz	0.3125 Hz	0.15625 Hz	78.125 mHz	39.0625 mHz
2 k	10 Hz	5 Hz	2.5 Hz	1.25 Hz	0.625 Hz	0.3125 Hz	0.15625 Hz	78.125 mHz
5 k	25 Hz	12.5 Hz	6.25 Hz	3.125 Hz	1.5625 Hz	0.78125 Hz	0.390625 Hz	0.1953125 Hz
10 k	50 Hz	25 Hz	12.5 Hz	6.25 Hz	3.125 Hz	1.5625 Hz	0.78125 Hz	0.390625 Hz
20 k	100 Hz	50 Hz	25 Hz	12.5 Hz	6.25 Hz	3.125 Hz	1.5625 Hz	0.78125 Hz

Table 1 Relationship of Frequency Range When Zooming is Used and the Frequency Resolution

FREQUENCY RANGE (Hz)	ANALYZED DATA LENGTH							
	× 1 (OFF)	× 2	× 4	× 8	× 16	× 32	× 64	× 128
1 Hz	200 S	400 S	800 S	1600 S	3200 S	6400 S	12800 S	25600 S
2	100 S	200 S	400 S	800 S	1600 S	3200 S	6400 S	12800 S
5	40 S	80 S	160 S	320 S	640 S	1280 S	2560 S	5120 S
10	20 S	40 S	80 S	160 S	320 S	640 S	1280 S	2560 S
20	10 S	20 S	40 S	80 S	160 S	320 S	640 S	1280 S
50	4 S	8 S	16 S	32 S	64 S	128 S	256 S	512 S
100	2 S	4 S	8 S	16 S	32 S	64 S	128 S	256 S
200	1 S	2 S	4 S	8 S	16 S	32 S	64 S	128 S
500	0.4 S	0.8 S	1.6 S	3.2 S	6.4 S	12.8 S	25.6 S	51.2 S
1 k	0.2 S	0.4 S	0.8 S	1.6 S	3.2 S	6.4 S	12.8 S	25.6 S
2 k	0.1 S	0.2 S	0.4 S	0.8 S	1.6 S	3.2 S	6.4 S	12.8 S
5 k	40 mS	80 mS	160 mS	320 mS	640 mS	1.28 S	2.56 S	5.12 S
10 k	20 mS	40 mS	80 mS	160 mS	320 mS	640 mS	1.28 S	2.56 S
20 k	10 mS	20 mS	40 mS	80 mS	160 mS	320 mS	640 mS	1.28 S

Table 2 Relationship of Zoomed Frequency Range and Analyzed Data Length

2. OPERATION

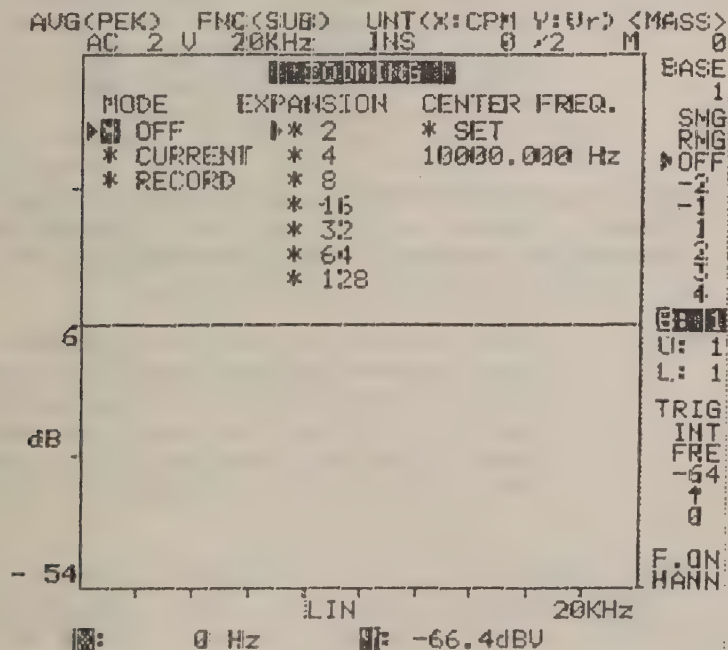
2.1 Operation Procedure

Set the attenuator range and frequency to the optimum settings and follow the procedure below using the front panel switches.

2.1.1 Press the E-4 SET UP switch group ZOOM switch.

Note: If FUNCTION had been set, pressing ZOOM will be ignored by the system. In such cases, press ZOOM only after cancelling FUNCTION.

2.1.2 After performing the above setting, the CRT will be used to perform the remainder of the setup.



Display Meaning

Mode	Expansion ratio	Center Frequency
* OFF	*x2	* Set
* Current	*x4	10,000,000Hz
(real time zoom)	*x8	
* Record (transient	*x16	
zoom)	*x32	
	*x64	
	*x128	

Note: The ZOOM switch should be pressed when a single display is output for DISPLAY or when the lower spectrum is indicated for a dual SPECT display. Note that in the TIME waveform display mode, the center frequency may not be set.

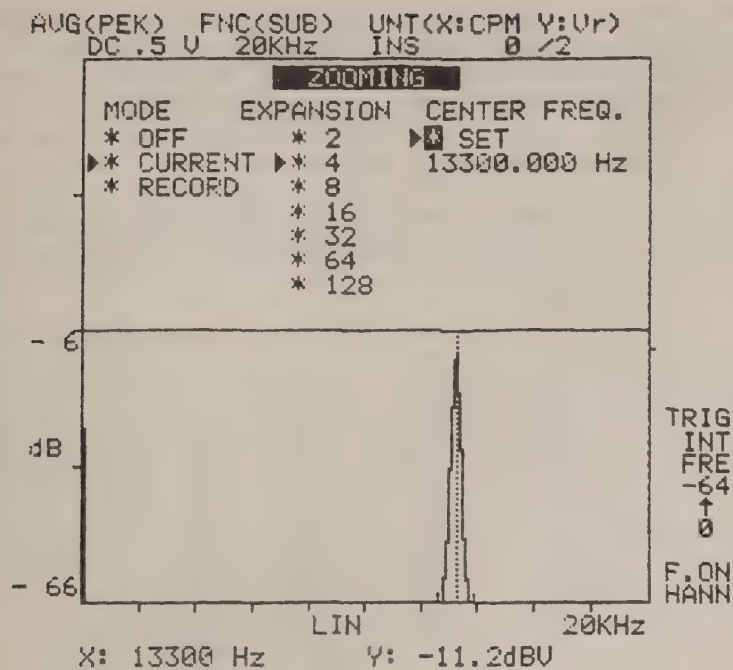
- 2.1.3 Press the E-12 CURSOR switch, moving the cursor to CURRENT, after which the E-10 ENTER switch is pressed to record this information. This starts the zooming process.

Note: The ZOOM mode may be used to perform zooming on hardware-input signals using the CURRENT mode or, using the CF-031 option, it may be used to perform the same type of zooming on a stored time axis waveform in the RECORD mode.

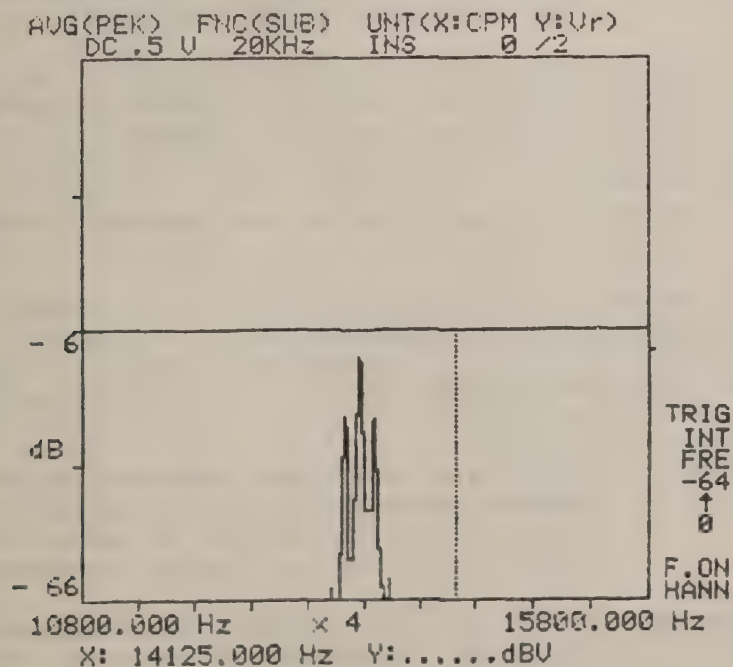
- 2.1.4 Next, using E-9, E-11, and E-12, move the cursor to the right to select the expansion ratio, entering this value using the E-10 ENTER switch.

- 2.1.5 Next, using the E-9, E-11, and E-12 switches, move the cursor to the right to select the desired center frequency, and use F-17 and F-15 to move the search point to the center frequency you wish to expand, recording this data using the E-10 ENTER switch.

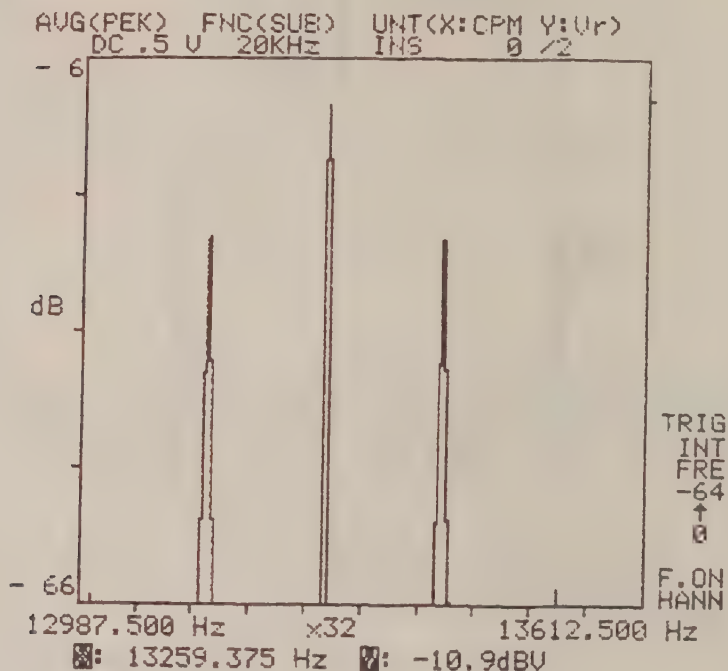
The display below is an example of the center frequency set to 13300Hz.



2.1.6 Press the C-1 START switch or the D-2 AVG switch to execute the ZOOM mode. The following is an example of the resulting display.



- 2.1.7 If the DISPLAY SPECT switch F-14 is pressed two times after the display of the example display of Section 2.1.6 and a single display is obtained, the F-3 EXPSN switch can be pressed three times to obtain a display expanded by 32 times as shown in the example display below.



Also, because the search function F-18 is OFF, the spectrum X-axis frame line and the analysis range is indicated as from 12987.500Hz to 13612.500Hz.

2.2 Center Frequency Value and Setting Procedure

- 2.2.1 The center frequency value is set by following the procedure described below.

- (a) Using SET UP to Set the Value of Center Frequency

Press the E-4 ZOOM switch to display the ZOOMING menu on the CRT display. Use the cursor and ENTER switch to select the desired search point as the center frequency.

- (b) Using the ENTER Switch Only to Set the Value of Center Frequency

Only during the execution of ZOOM, press the E-10 ENTER switch only for automatic selection of the search point.

Note 1. Although, when using ZOOM it may happen that negative frequencies or frequencies outside of the frequency range may appear in the display, these values are not valid and settable.

2. Regardless of whether the search function is ON or OFF, the X-axis search value is set as the center frequency.

2.2.2 Center Frequency Value

The center frequency value is stored as a fraction of the set frequency range. For this reason, changing the frequency range will naturally change the center frequency as well.

Example: In the 20kHz range, the frequency of 1.6kHz is set as the center frequency for zooming. If the frequency range is switched to 2kHz, the new center frequency becomes 160Hz.

The center frequency may be set with a resolution of up to $1/32$ of the frequency range resolution. Therefore, for x64 and x128 zooming, not the actual set value of frequency, but the closest actual value is used as the center frequency.

2.3 Changing the Expansion Ratio

Once the center frequency has been set and after execution of ZOOM, the value of expansion ratio can be changed simply by following the procedure described below.

Use F-3 and F-4 of the DISPLAY switch group to change the expansion ratio as indicated in the EXPSN portion of the menu. To increase the ratio, push the upward pointing switch, and to decrease it, push the downward pointing switch. The downward pointing switch is also used to stop the zooming process. The expansion ratio changes every time one of these switches is pressed.

2.4 About the Panel Setup Memory

The panel setup memory of the CF-300 stores the ZOOM expansion ratio as well as the center frequency value. Note, however, that this storage is not made in the ZOOM mode. Using the panel setup memory switch, START is selected, with the ZOOM mode OFF.

Frequency axis expansion operates on the following principle.

As can be seen from normal operation, it is quite simple to increase the resolution in the frequency axis about the DC point by merely lowering the frequency range. For this reason, if you shift the part of the spectrum you wish to expand to the DC region the same effect can be achieved. After the shift, filtering to eliminate aliasing is performed much the same as for normal processing, and the signal is sampled. This scheme makes it quite easy to select a combination of filter and sampling rates that effectively shifts the input signal to the DC resolution for a dramatic increase in resolution.

The above described process is achieved digitally in the CF-032. The process is described in block form below.

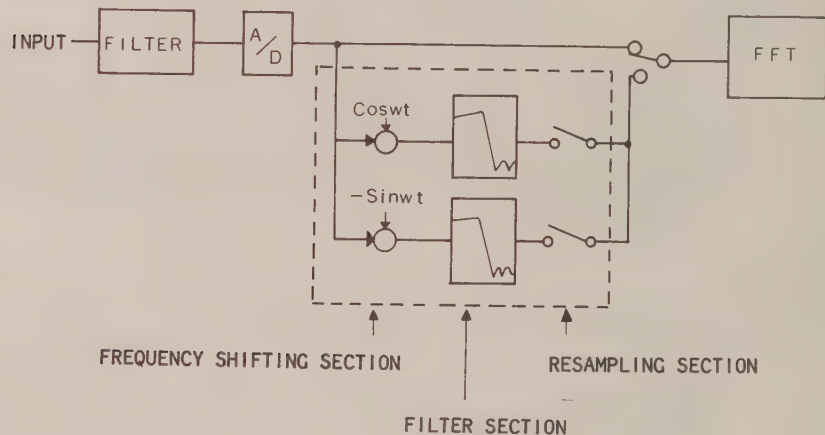
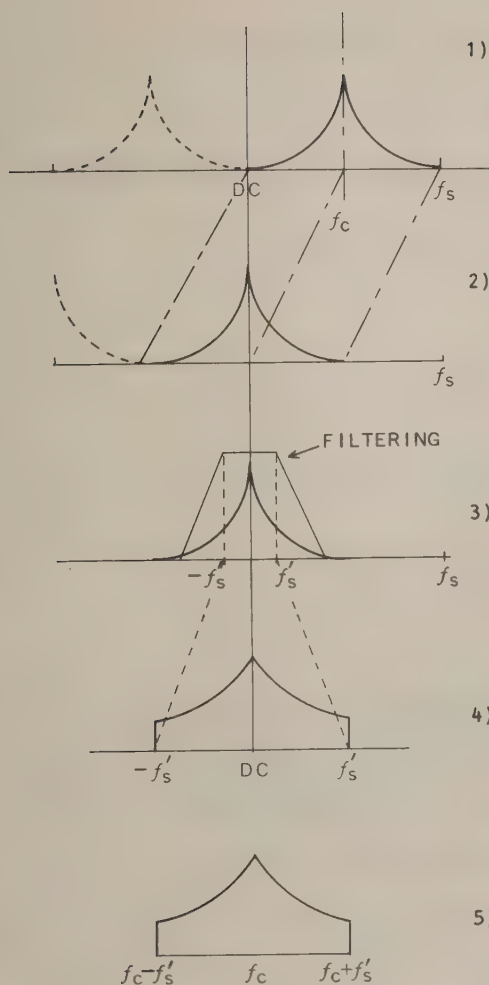


Fig. 1 Digital zooming process block diagram

In the above figure, the sections enclosed in dotted lines are located on the CF-032 board.



1) In normal analysis mode, the range of frequency from DC to f_s is displayed.

2) Frequency shifting is done so that f_c falls just at the DC line.

3) Antialiasing filtering is performed

4) Resampling is performed to expand the frequency range

5) The results are displayed as frequency components from $f_c - f_s$ to $f_c + f_s$.

Fig. 2 Zoom principle frequency domain transformations

CF-034 XY-Plotter Interface Package Option

Instruction Manual

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1. INTRODUCTION

The CF-034 XY-Plotter Interface is used to output the CF-300 CRT information to the CX-337 Color Plotter.

- 1.1 This interface is inserted into any of the three slots at the rear of the CF-300 mainframe.
- 1.2 When this interface is installed, as the power supply is applied to the CF-300, the front panel PLOTTER CONTROL STOP switch LED will light. Also, you should verify that switch E-14 (VIEW) causes OPTION PLOTTER ON to appear in the CRT display.
- 1.3 The CF-300 and CX-337 Color Plotter are connected by means of a specially provided cable. This cable is supplied as an accessory to the Color Plotter.
- 1.4 Plotter Interface Functions
 - 1.4.1 The plotter interface is used to create a hardcopy in color of all the CF-300 CRT information with the exception of the SET UP information (displayed by means of E-1 thru E-8).
 - 1.4.2 Both CRT COPY and running three-dimensional copies are possible, and if the CF-031 Mass Memory Card Option has been installed in the CF-300, three additional plot types are added (time record, transient trace, and real-time trace).
 - 1.4.3 Either A-4 or A-6 size may be selected as the copy output size (refer to section 4.1).
 - 1.4.4 Color plotting is produced by an automatic four-color hand selecting mechanism. The information from the CF-300 screen, however, is plotted in a maximum of three colors.
 - 1.4.5 The commands to begin and stop color plotting operations are given by the CF-300 H-1 PLOTTER CONTROL START button and H-2 STOP button. For details, refer to section 4 on operation.

- 1.4.6 If the CF-033 GP-IB interface package is installed in the CF-300 along with the CF-034 Plotter Interface, the GP-IB interface may be used to interface an external CPU to the CF-300, thus enabling the external CPU to control color plotting operations (for details, refer to CF-033 GP-IB package instruction manual, the section describing the GP-IB command (CDO)).

2. COPY FUNCTIONS

2.1 Types of Copy Output

- 2.1.1 Five types of copies are creatable using the plotter interface. The first two only are available if the CF-031 Mass Memory Card has not been installed in the CF-300 mainframe, however.

Copy type	Description
CRT Copy	This copy creates an output that includes all of the CRT information. It is executed in the PAUSE mode (i.e., when the PAUSE pushbutton switch C-2 has been pressed). (Note that the SET UP display information output to the CRT using E-1 thru E-8 push-buttons is not output to the plotter.)
Running Three-Dimensional	This output contains the CRT information (lower portion of the CRT for a dual display) which is output each time START is executed (i.e., when the START C-1 pushbutton switch is pressed), thus creating a three-dimensional color plot.
(In addition to the above two copy types, the following three types are available if the CF-031 has been fitted to the CF-300 mainframe.)	
Time Record	This copy consists of the raw time waveform stored in mass memory from the 512th to the 8192nd point, plotted on a single frame.
Transient Trace	This copy consists of a continuous 256-point output of the search point or the maximum value from the spectral conversion of the raw time-axis waveform stored in mass memory.
Real-Time Trace	This copy consists of a continuous 256-point output of the search point or maximum value of an analyzed spectrum.

- 2.1.2 Refer to the following listed sections for a description of the copy types and the corresponding operating procedures.

Copy type	Description (Section)	Operation (Section)
CRT Copy	3.1	4.2
Running Three-Dimensional	3.2	4.3
Time Record	3.3	4.4
Transient Trace	3.4	4.5
Real-Time Trace	3.5	4.6

2.2 Pens Used for the Various Types of Copies

The CX-337 Color Plotter can be used with four pens (numbers 1 thru 4) so that any four colors (black, blue, red, and green) can be used.

The five types of CF-300 plotter output can be created by using any three colors of these four, the pens being automatically selected.

The use of the various colors for these five types of plots (i.e., the colors used for waveforms, framelines, search markers, and characters) is as described in the following table.

Copy type	Waveforms	Axes and search markers	Characters
CRT Copy	n-th	2nd	3rd
Running Three- Dimensional	n-th	-	-
Time Record	n-th	2nd	2nd
Transient Trace	n-th	2nd	2nd
Real-time Trace	n-th	2nd	2nd
Setup View	-	-	n-th

(In the table above, the n-th pen (color) refers to the pen setup at the beginning of plotting. This is usually automatically selected as the first pen.)

The color selection for double spectrum overlay copies is as follows.

Using the F-9 FUNC pushbutton, before executing the overlay plot, the upper and lower CF-300 CRT spectra are plotted using the n-th pen, the upper displayed spectrum using the 2nd pen, axes using the 2nd pen and characters using the 3rd pen.

2.3 Reverse Display and System Reset

2.3.1 Characters which are displayed reversed (black/white reverse) on the CRT are plotted as underlined characters.

2.3.2 When a normal termination of plotting output has occurred, the plotting serial number starting at the time when the power supply has been applied or starting whenever the SYSTEM RESET is pressed is printed in the lower righthand portion of the plot.

3. COPY TYPE DESCRIPTIONS

This section will serve to describe the types of copies as specified in section 2.1.

As described in the table in section 4. (OPERATION - Setting Conditions), the following three selections and settings can be used to produce copies.

- (a) CF-300 command switches, C-1 START pushbutton and C-2 PAUSE pushbutton.
- (b) CF-300 CRT right-edge character display: reproduction expansion -2 4 and OFF.
- (c) MASS MEMORY FUNCTION category (displayed when the E-6 MASS pushbutton is pressed): BASE, ZOOM, OTHER and OCT.

Note that (b) and (c) require that the CF-031 Mass Memory Card Option be fitted into the CF-300.

For details on operating procedures for the above, refer to section 4. (OPERATION).

3.1 CRT Copy

For details on operating procedures refer to section 4.2.

3.1.1 For a CF-300 Fitted With the CF-031 Mass Memory Card Option.

- (a) With the CF-300 in the PAUSE condition (i.e., when the C-2 PAUSE pushbutton has been pressed), all CRT information is copied. Note, however, that the SET UP character display section (the upper portion of the CRT display when the E-1 thru E-8 pushbuttons are pressed), is not copied.
- (b) The SET UP VIEW characters can be copied. (By pressing the C-2 PAUSE pushbutton and then VIEW.)
- (c) Of the CF-300 CRT information, the X-axis LOG scaled three-dimensional display which could not be CRT displayed, can be copied using the color plotter.

Press the E-3 FUNC pushbutton, select ARRAY, and, after entering this, press the F-2 X-LOG pushbutton and then use the F-9 FUNC pushbutton to present a three-dimensional display. In the C-2 PAUSE condition, it is possible to three-dimensionally display the X-axis with log scaling.

3.1.2 For a CF-300 Not Fitted With the CF-031 Mass Memory Card Option

- (a) When the cursor is set to the OFF of the CF-300 CRT right-edge character display (i.e., when the mass memory time record function is not used), with the CF-300 in the PAUSE condition (i.e., when the C-2 PAUSE pushbutton has been pressed), all of the CRT information can be copied.
- (b) Set the cursor to the CF-300 CRT right-edge character display -2 4, set the MASS MEMORY FUNCTION to either BASE or ZOOM and, after entering, with the CF-300 in the PAUSE condition, the data used for the mass memory time record function (spectrum, time-axis waveform, three-dimensional display) can be copied.
- (c) Set the CF-300 CRT right-edge character display OFF or set the cursor to -2 4. Press the E-6 MASS pushbutton, and select and enter the MASS MEMORY FUNCTION of OCT. With the CF-300 in the PAUSE condition, the results of octave analysis can be copied.
- (d) For the sections (a) thru (c) above, the SET UP section characters (displayed on the upper portion of the dual CRT display when E-1 thru E-8 are pressed) may not be copied.
- (e) As in section 3.1.1 (b), it is possible to copy the characters of the SET UP VIEW (E-14).
- (f) As in section 3.1.1 (c), the three-dimensional LOG scaled X-axis display not possible to view on the CRT may be copied.

When doing this, the following three displays may also be put into LOG X-axis scaling.

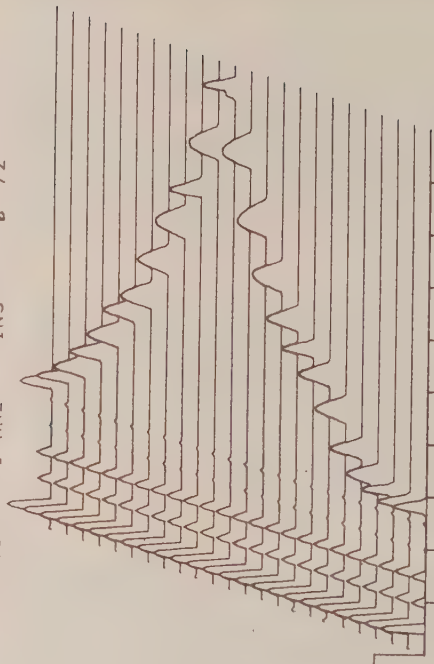
 - (1) The three-dimensional display with the CF-300 CRT right-edge character display OFF, and not using the mass memory.
 - (2) The three-dimensional display a transformed waveform that was stored in mass memory. (Refer to the CF-031 section 3.3, Note 2.)
 - (3) The three-dimensional spectrum display stored in mass memory using the F-13 M-IN pushbutton. (Refer to the CF-031 Instruction Manual, section 3.7.)

CRT COPY EXAMPLE (A6 SIZE)

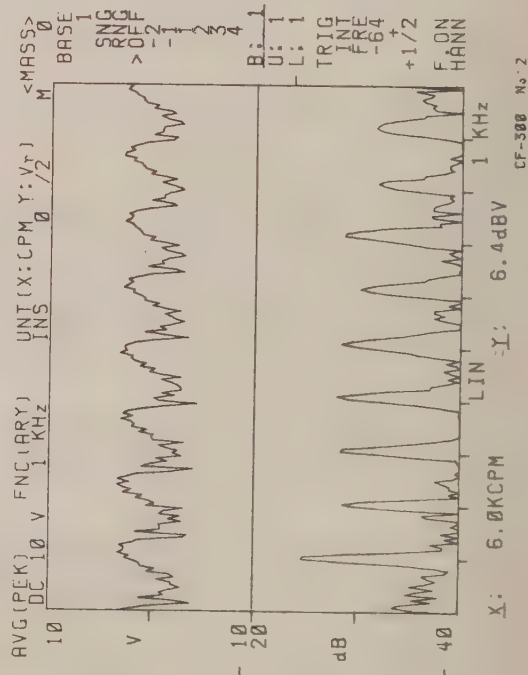
```

model1 CF-300 PORTABLE FFT ANALYZER
<< SETUP VIEW >>
1 INPUT
  DC 20 V
  FILTER:ON
2 FREQUENCY
  20KHz
  dt= 100 Hz dt= .020mSEC
3 TRIGGER
  PRE INT LEVEL( 0 )
  POSITION(-64)
4 ANALYSIS
  PEAK SUM.#= 2
  WINDOW:HANN
5 DISPLAY
  X-AXIS
  Y-AXIS
  FUNCTION
  SUB
  LOG( 60dB)
  EU=1000E+0mV
  UNIT(CPM)
  UNIT(Vrms)
6 OPTION
  Addr= 3
  GP-IB
  MASS
  ZOOM
  PLOTTER
  I & D
  mfd.by QNQ SOKKI
  
```

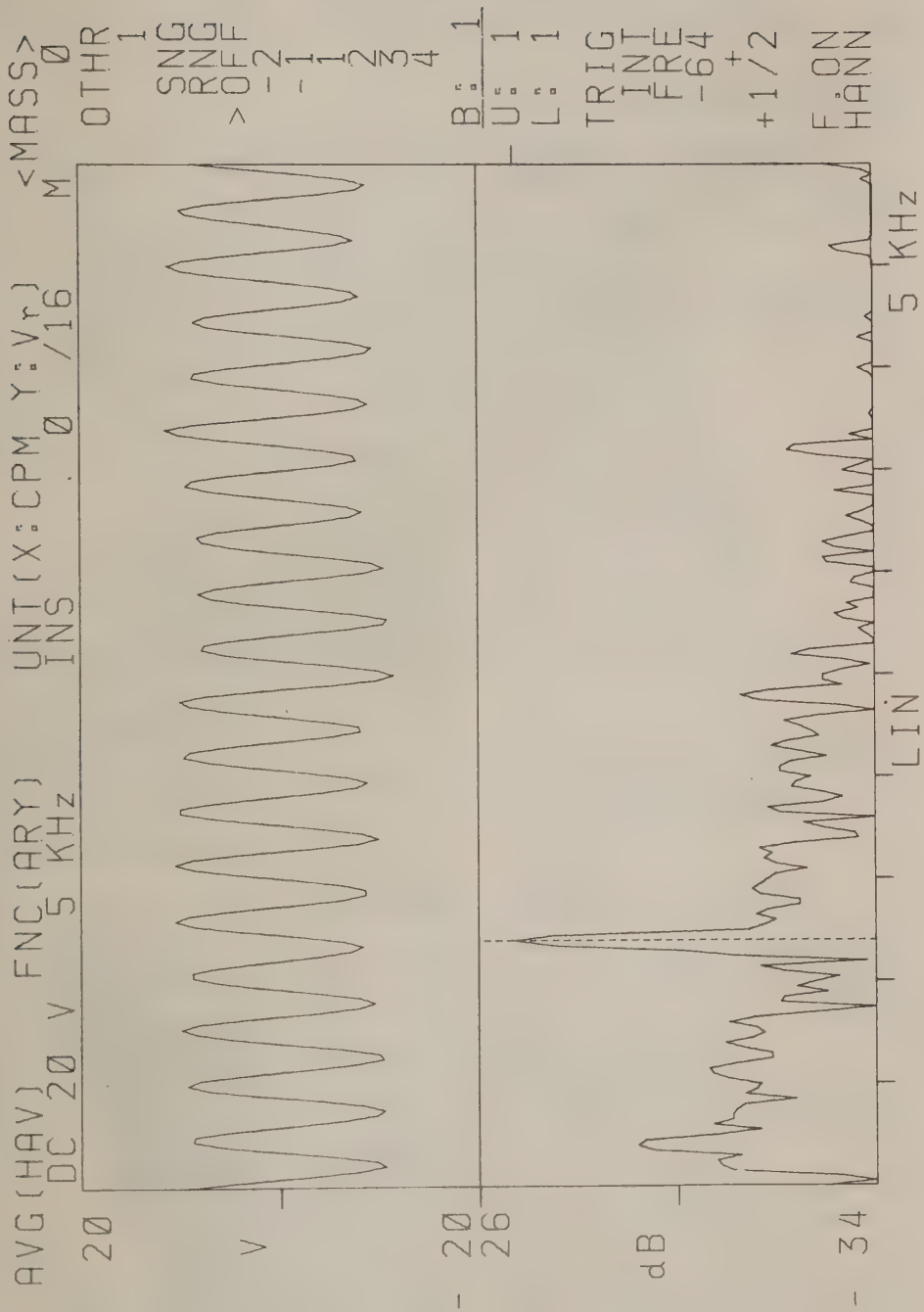
AVG(PEK) AC 10 V FNC(ARY) 1 KHz
INS 0 /2



CF-300 No.1



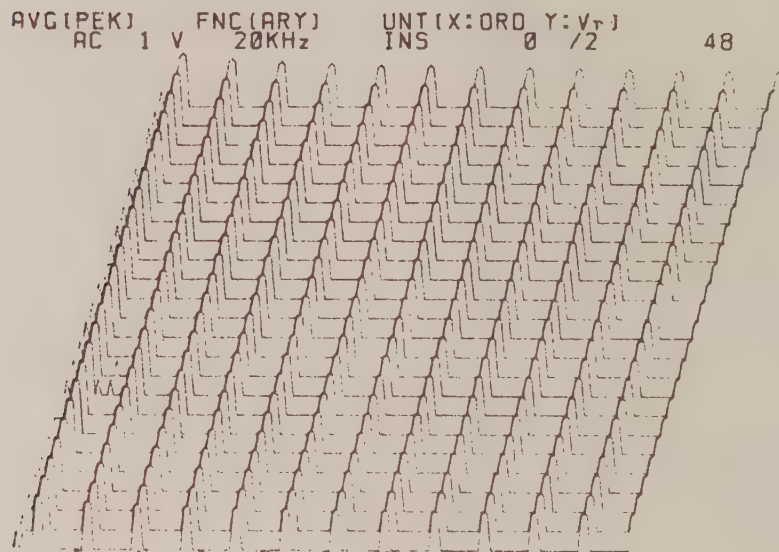
CRT Copy Example (A4 Size)



CF-300 No: 9

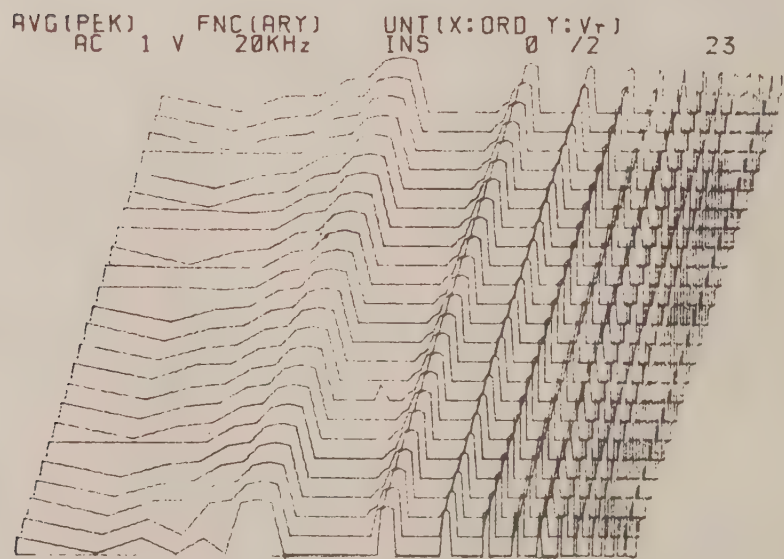
Examples of Three-Dimensional Hardcopies Produced
Using the CRT Copy Function (LIN and LOG Scaled
Plots)

LIN Scaling



CF-300 No. 4

LOG Scaling



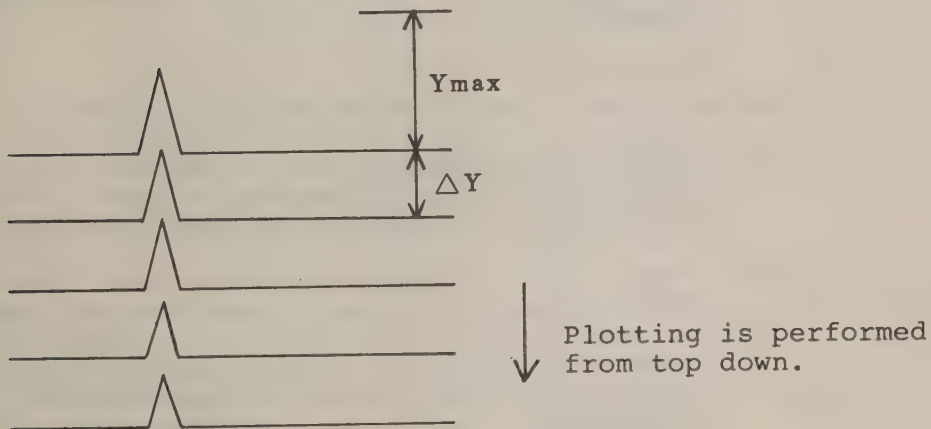
CF-300 No. 5

3.2 Running Three-Dimensional Recording

For details of operating procedures, refer to section 4.3.

The term running three-dimensional display refers to a continuous sequential display of time waveforms, spectra, and histograms created as a result of CF-300 analysis, which are plotted on the color plotter from top to bottom in three-dimensional fashion to enable time variations to be observed in real time.

For a double (upper and lower) CRT display, the lower portion of the CRT is output. The figure below shows the direction of plotting as well as plot size.



* For A4 size plotting:

Y (Data interval): 10mm (For single or double frames)

$Y_{\max}$ (Y-axis maximum value):
Single frame: 40mm
Double frame: 20mm

* For A6 size plotting:

1/2 the values for A4 described above.

3.2.1 For a CF-300 Not Fitted With a CF-031 Mass Memory Card

- (a) With the CF-300 in the START condition (i.e., when the C-1 pushbutton is pressed), spectra and other analysis results from the CRT display, are sequentially output to the color plotter to create a three-dimensional plot.

- (b) In the AVERAGE MODE (i.e., When E-6 is pressed)

Make and enter the following selections.

LIN SUM (Linear spectrum averaging)

TIME AVG (Time-axis averaging)

TIME ABS (Time-axis absolute value averaging)

HIST AVG (Amplitude probability density
function linear averaging)

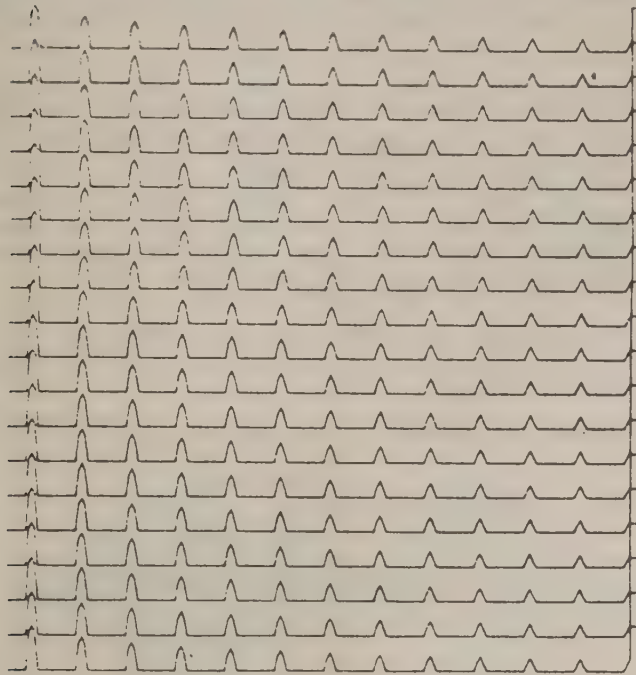
For the above setting, the waveforms corresponding to the selected number of averages will be output. The averaged result, however, will not be output.

3.2.2 For a CF-300 Fitted With a CF-031 Mass Memory Card

- (a) When not using the mass memory (i.e., when the CF-300 CRT right-edge is set to OFF), plotting is the same as for section 3.2.1).
- (b) When using the mass memory, set the MASS MEMORY (press E-6 MASS) function to BASE or to ZOOM and enter. Select -2 4 on the CRT right-edge display. As the waveform stored in mass memory is displayed on the CRT, this information will be plotted in three-dimensional fashion.
- (c) To three-dimensionally plot the results of an octave analysis, set the MASS MEMORY (push E-6 MASS) FUNCTION to OCT and enter. Use exponential averaging (press E-1 and select and enter EXP SUM, executing by pressing the D-2 AVG pushbutton). Note that INST (D-1) can not be used to produce a running three-dimensional plot.

The running three-dimensional plot is initiated by pressing the C-1 START.

Running Three-Dimensional Copy Example



3.3 Time Record

For details of operating procedures, refer to section 4.4.

3.3.1 To create a copy of a time record, it is necessary that the CF-300 be fitted with the CF-031 Mass Memory Card Option.

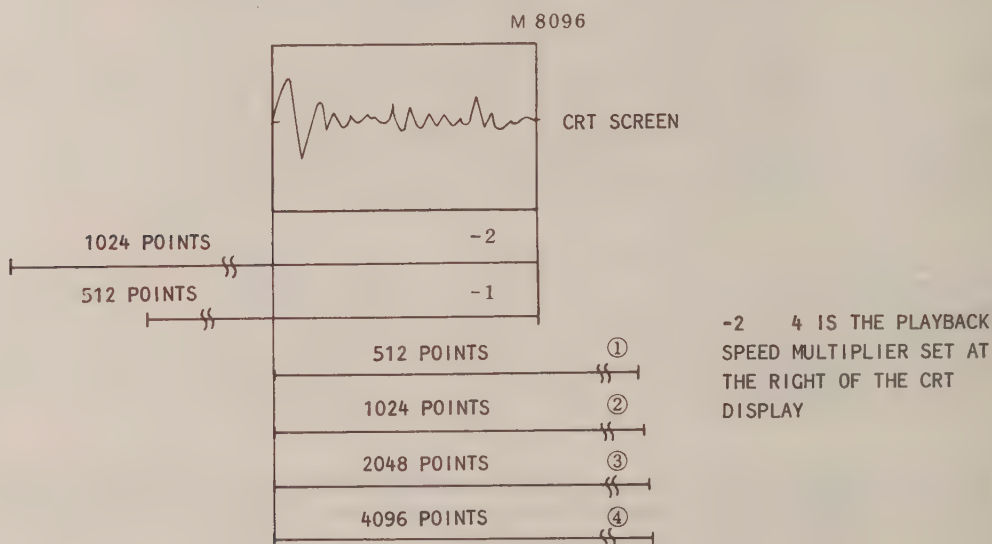
3.3.2 The time record copy consists of a maximum of 8192 points of the 32k words of time-axis waveform stored in the mass memory.

While the CF-300 CRT is capable of displaying only 200 points at a time, by using this copy function, a single copy (one or two frames) can be used to plot the waveform from the 512th point to 4096th point, providing an easy means of observing time variations of the waveform over long periods.

3.3.3 Two types of copies are possible, a single-frame and a double-frame. For the single-frame copy, the number of points indicated in the figure below only are plotted. For the double-frame copy, the plot as indicated in the figure below is made first, after which the same number of points are plotted for the upper frame. Therefore, a maximum of 8192 points are output. Note, however, that when the end of the mass memory capacity (the 32,768th point) is plotted for the lower frame, the first part of the mass memory contents is plotted in the upper portion.

3.3.4 When starting at the ending address of the mass memory, plotting is made up to the 32,768th point.

Selection of number and output section of data.



3.3.5 The number of data points to be output is selected by setting the playback speed multiplier at the righthand edge of the CRT display in the range of -2 4, as described below.

Playback speed multiplier	No. of data points
-2	1024
-1	512
1	512
2	1024
3	2048
4	4096

3.3.6 The X-axis time will be displayed in the lower-right portion of the copy, this value corresponding to the lower frame.

Relationship of Frequency Range and Number of Data Points to X-Axis Time

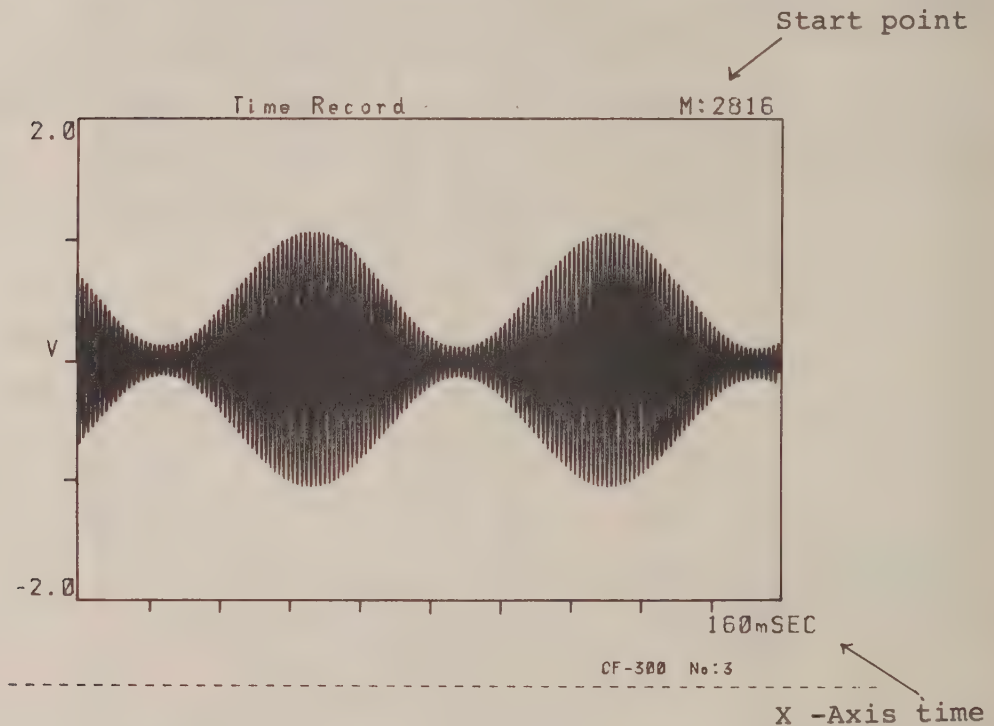
Frequency range	No. of data points			
	512	1024	2048	4096
20kHz	10ms	20ms	40ms	80ms
10kHz	20	40	80	160
5kHz	40	80	160	320
2kHz	100	200	400	800
1kHz	200	400	800	1600
500Hz	400	800	1600	3200
200Hz	1s	2s	4s	8s
100Hz	2	4	8	16
50Hz	4	8	16	32
20Hz	10	20	40	80
10Hz	20	40	80	160
5Hz	40	80	160	320
2Hz	100	200	400	800
1Hz	200	400	800	1600

Note: Even if EXT CLOCK is used for sampling, the time is output in the copy as shown in the above table.

3.3.7 In the upper-right portion of the copy, the M.XXX and START point mass memory address are output.

- 3.3.8 When the last portion of the mass memory contents, for example, starting at address 32000 and plotting 4096 points, is selected, the actual starting address (in this case $32768 - 4096 = 28672$) is output in the upper-right portion of the plotted copy.

Time Record Copy Example

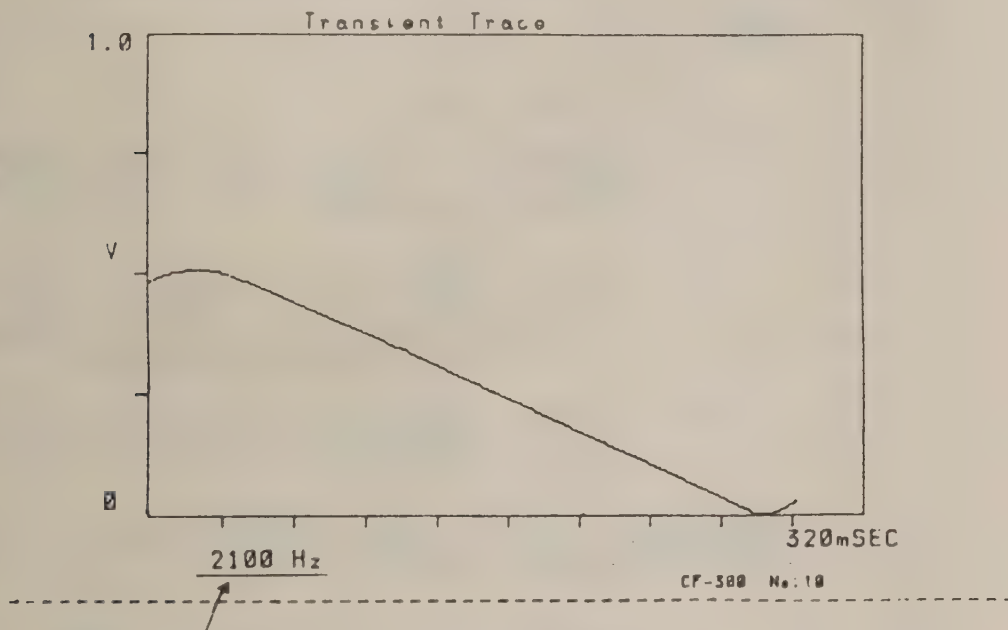


3.4 Transient Trace

For details of operating procedures, refer to section 4.5.

- 3.4.1 To produce a transient trace copy, the CF-300 must be fitted with the CF-031 Mass Memory Card Option.

Transient Trace Copy Example



The search point frequency is output only when search is ON.

Do not provide output in case of "Search off"

- 3.4.2 The spectrum converted from a time-axis waveform stored in mass memory is displayed on a CF-300 screen and a continuous 256-point color plot is output of the search point or the maximum point of the resulting spectra.
- 3.4.3 This type of copy can be used in such analysis applications as reverberation characteristics analysis resulting from transient signals.
- 3.4.4 A transient trace is also possible for a transformed spectra from a recorded waveform which has been expanded using the RECORD zooming function.

- 3.4.5 The X-axis (time) of the color plotted trace will vary depending upon the playback speed of the recorded waveform and the frequency range.

The horizontal fullscale is:

$$T = \frac{1}{2.56 \times F} \times S \times M \times 256 = \frac{100}{F} \times S \times M \text{ (s)}$$

Where

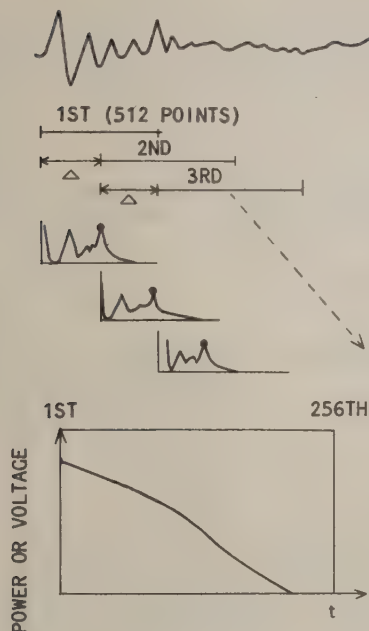
- T: X-Axis time (s)
- F: Frequency range (i.e., the frequency range at the time the time-axis waveform was recorded)
- S: Playback speed of 1, 4, 16, 64, 256, or 1024 (MASS MEMORY SPEED which is displayed when the E-6 MASS pushbutton is pressed) selected and entered.
- M: Playback magnification (-1, -2), 1, 2, 3, 4, (characters displayed at the right edge of the CRT)

For example, if $F = 20\text{Hz}$, $S = 16$, and $M = 4$, the X-axis fullscale time is:

$$\frac{100}{20,000} \times 16 \times 4 = 0.32\text{s} = 320\text{ms}$$

- 3.4.6 With $S \times M = 128$, all the stored data is traced, and with $S \times M = 64$, half of the data is traced.
- 3.4.7 256 Points are output, the spectra for these points being transformations from the time-axis waveform as shown below. If the first spectrum is not zoomed (i.e., if E-6 MASS is pressed for MASS MEMORY MODE of BASE), 512 points will result. If zoom is used, however, (MASS MEMORY MODE of ZOOM) 1024 16384 points will result.

TRANSIENT TRACE
CONCEPTUAL DIAGRAM



Mass Memory Recorded Waveform

1. $= S \times M$ (points)
2. Number of data points each time:
 - a. For the BASE MASS MEMORY mode, 512 points.
 - b. For the ZOOM MASS MEMORY mode, the number of points depends upon the ZOOM magnification as shown below.

Expansion (multiplier)	No. of points
*2-	1024
*4-	2048
*8-	4096
*16-	8192
*32-	16384

As shown in the figure above, the spectral level for a given frequency is output at a fixed time interval ().

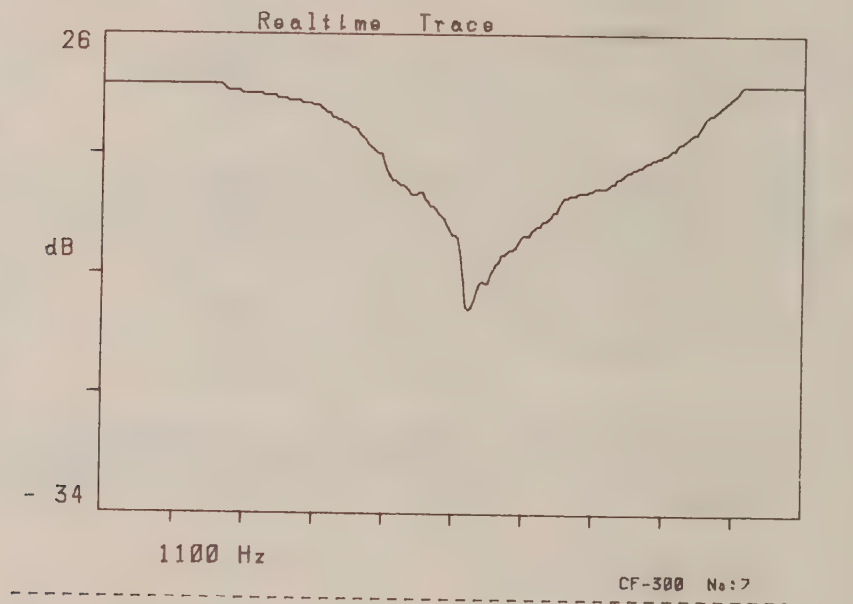
3.5 Real-Time Trace

For details of operating procedures, refer to section 4.6.

- 3.5.1 To use the real-time trace copy function, the CF-300 must be fitted with the CF-031 Mass Memory Card Option.
- 3.5.2 The real-time trace copy function does not use the waveform recorded in mass memory, but uses instead newly captured data, providing a continuous plot of 256 points of the search value or the maximum value, in real time.
- 3.5.3 Using this type of copy, it is possible to plot in real time the variations of power spectrum for a particular frequency (this is done with the CF-300 in the START condition, i.e., by pressing the C-1 START pushbutton).

- 3.5.4 The spectra must be in LIN X-axis scaling.
- 3.5.5 If the CF-300 is fitted with the CF-032 Real-Time Zoom Card, it is possible to output the search value and maximum value trace for a spectra zoomed in real-time.
- 3.5.6 Since the X-axis of this type of copy is not scheduled, it is not output.

Real-Time Trace Copy Example



This section will serve to describe the operating procedures used to execute the various types of copies described in section 3.

Starting and stopping copying operations is performed by the CF-300 PLOTTER CONTROL START and STOP pushbuttons (H-1 and H-2).

Also, to execute the copy types described in sections 3.1 thru 3.5, the setting conditions listed in the following tables must be satisfied.

For a CF-300 Not Fitted With a CF-031 Mass Memory Card

Copy type	Setting conditions
CRT Copy	The CF-300 must be in the PAUSE condition (i.e., the C-2 PAUSE button has been pressed)
Running Three-Dimensional Display	The CF-300 must be in the START condition (i.e., the START pushbutton has been pressed)

For a CF-300 Fitted With a CF-031 Mass Memory Card
Option:

Setting conditions Copy type		a	b	c	d
		CF-300 START/ PAUSE	CRT Right-edge Display	MASS MEMORY FUNCTION	Other Conditions
		S P T A A U R S T E	-2 0 F F 4	B Z O O A O T C S O H T E M E R	
CRT Copy					
	32K word time-axis waveform stored in mass memory not used.	X 0	0 X	- - X X	
	32K word time-axis waveform stored in mass memory used.	X 0	X 0	- - X X	
	Copy of the results of an octave analy- sis.	X 0	- -	X X X 0	
	Copy of the CRT data stored in mass memory.	X 0	- -	- - X -	
	Copy of the SET UP VIEW data.	X 0	- -	- - - -	Press VIEW

Setting conditions Copy type		a	b	c	d
		CF-300 START/ PAUSE	CRT Right-edge Display	MASS MEMORY FUNCTION	Other Conditions
		S P T A A U R S T E	-2 0 F F 4	B Z O O A O T C S O H T E M E R	
Running Three- Dimensional Copy					
	32K word time-axis waveform stored in mass memory not used.	0 X	0 X	- - X X	
	32K word time-axis waveform stored in mass memory used.	0 X	X 0	- - X X	
	Copy of the results of an octave analy- sis.	0 X	- -	X X X 0	Perform LOG averaging
Time Record		X 0	X 0	X X 0 X	
Transient Trace		0 X	X 0	X X 0 X	LIN X-axis scaled spectrum
Real-Time Trace		0 X	0 X	X X 0 X	LIN X-axis scaled spectrum

0: Conditions to be set for categories a,
b, and c

X: Conditions not to be set for categories
a, b, and c

-: Any one of the "-" items may be set

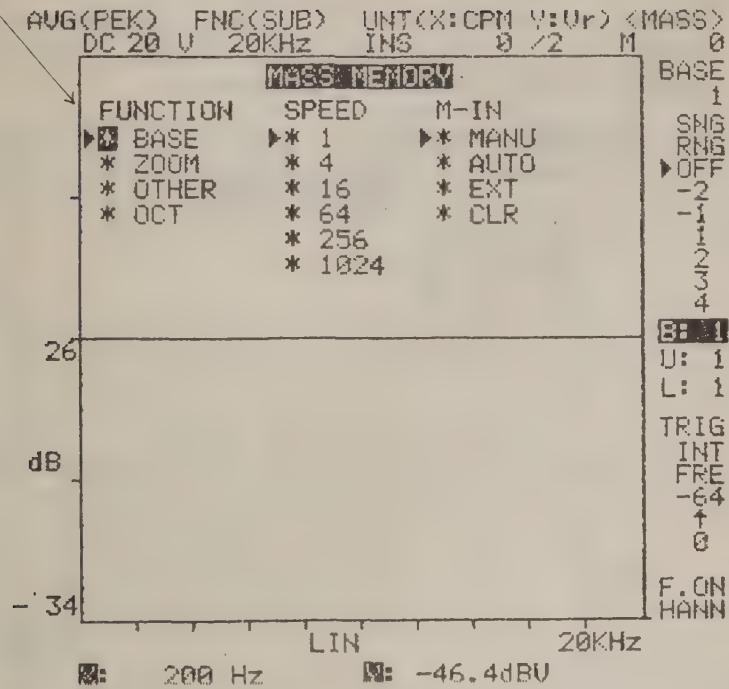
Settings of categories a, b, and c are performed according to the following method.

a	START Condition PAUSE Condition		Press the CF-300 COMMAND C-1 START pushbutton. Press the CF-300 COMMAND C-2 PAUSE pushbutton.
b	CF-300 CRT Right-edge character display	OFF	Set the cursor (using E-11 and E-12) to the OFF of the CF-300 CRT right-edge character display.
		-2 4	Set the cursor (using E-11 and E-12) to a value from -2 to 4 on the CF-300 CRT right-edge character display.
c	MASS MEMORY FUNCTION	BASE	Press the E-6 SET UP MASS pushbutton to display the MASS MEMORY FUNCTION category. Using E-11 and E-12, set the cursor to BASE and enter using the E-10 ENTR pushbutton.
		ZOOM	In the same manner as for BASE, set ZOOM and enter.
		OTHER	In the same manner as for BASE, set OTHER and enter.
		OCT	In the same manner as for BASE, set OCT and enter.

(Refer to the following figure for setting locations.)

Category c set-
ting conditions

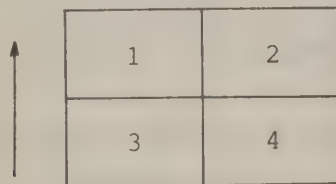
Category b set-
ting conditions



4.1 Changing the Copy Size

The color plotter can output either A4 or A6 size copies. The A6 size is one-fourth the dimensions of the A4 size, and plots in the A6 size mode in the sequence shown below.

A6 plot sequence:

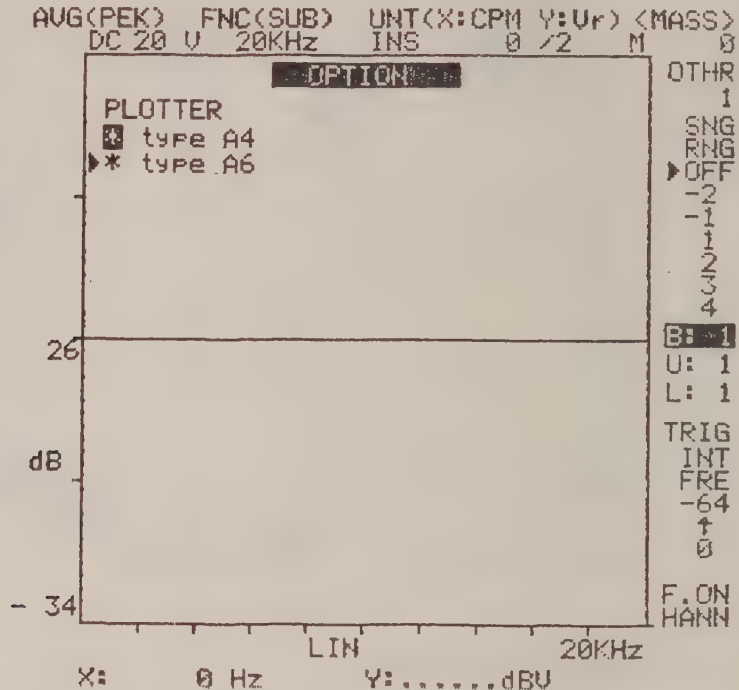


Plotting
is done
in the
sequence
1 4

Paper feed
direction

The procedure for changing the copy size is as follows.

- 4.1.1 Before starting the plotter output, press the E-8 SET UP OPTION pushbutton, to display the screen as shown below.
- 4.1.2 Using the E-11 and E-12 cursor pushbuttons, select either A4 or A6 size and enter this selection, using the E-10 ENTR pushbutton.



4.2 CRT Copy Operating Procedure

- 4.2.1 For a CF-300 Not Fitted With a CF-031 Mass Memory Card Option
 - (a) Call up to the CRT the analysis results (spectrum, time-axis waveform, histogram, or three-dimensional display) that you wish to copy.
 - (b) Press the C-2 PAUSE pushbutton.
 - (c) To copy the SET UP VIEW, press the C-2 PAUSE pushbutton, and then the E-14 VIEW pushbutton.
 - (d) Press the H-1 PLOTTER CONTROL START pushbutton.
 - (e) After performing step (d), the START LED only will light, indicating that the plotter is in the START mode. When the output of the CRT is completely written, the STOP mode will automatically be entered (the H-2 STOP LED will light).

- (f) After performing step (d), if the H-1 START pushbutton is pressed before the STOP mode is entered, both the START and STOP LEDs will light and the plotter will be put into the PAUSE mode.
- (g) In the PAUSE mode, the waveform only will be plotted and the plotter stopped, a new page (paper feed) not being performed. Therefore, when the H-1 START pushbutton is pressed once again, it is possible to perform a double copy over the same frame (i.e., for example a new spectrum on the same frame).
- (h) When the H-2 STOP pushbutton is pressed, the STOP LED will light, and the STOP mode will be enabled. The current output is stopped and a page is fed.

Even in the stop mode, however, since the color plotter output is buffered, data will be plotted. In this condition, the CF-300 can be used to perform the next operation.

4.2.2 For a CF-300 Fitted With a CF-031 Mass Memory Card Option

- (a) Procedure When a 32K Word Time-Axis Waveform Stored in Mass Memory is Not Used.
 - (1) Using the E-11 and E-12 pushbuttons, set the cursor to the OFF at the character display at the right edge of the CRT.
 - (2) Press the E-6 MASS pushbutton and select any mass memory FUNCTION other than OCT using the E-11 and E-12 pushbuttons. Enter this selection by pressing the E-10 ENTR pushbutton.
 - (3) Analysis will be performed as data is captured, whereupon the C-2 PAUSE pushbutton is pressed.
 - (4) Push the H-1 PLOTTER CONTROL START pushbutton.
- (b) Procedure When a 32K Word Time-Axis Waveform Stored in Mass Memory is Used.
 - (1) Store a time-axis waveform, following the procedure in the CF-031 Instruction Manual.
 - (2) Replay the stored time-axis waveform and call up to the CRT the portion to be copied. Press the C-2 PAUSE pushbutton to enable the PAUSE condition.

- (3) At step (2), select a value between -2 and 4 at the right edge of the CRT display, and MASS MEMORY FUNCTION as either BASE or ZOOM.
 - (4) Press the H-1 PLOTTER CONTROL START pushbutton.
- (c) To Copy the Results of an Octave Analysis
- (1) Push the E-6 MASS pushbutton, display the MASS FUNCTION, and select and enter OCT.
 - (2) Perform an octave analysis.
 - (3) Set the CF-300 into the PAUSE condition.
 - (4) Press the H-1 PLOTTER START pushbutton.
- (d) To Copy the CRT Data Stored in Mass Memory
- (1) Press the H-6 MASS pushbutton and display the MASS FUNCTION. Select any function with the exception of OTHER.
 - (2) Use the F-11 M-OUT pushbutton to recall to the CRT display the analyzed data stored in memory using the F-13 M-IN pushbutton.
 - (3) Put the CF-300 in the PAUSE condition, and press the H-1 PLOTTER START pushbutton.
- (e) To Copy the SET UP VIEW
- (1) Press the C-2 PAUSE pushbutton to place the CF-300 in the PAUSE condition.
 - (2) Press the E-14 VIEW pushbutton.
 - (3) Press the H-1 PLOTTER START pushbutton.
- (f) To Copy the Three-Dimensional Display
- (1) Execute the three types of three-dimensional displays described in section 3.1 (CRT Copy).
 - (2) To copy a three-dimensional display with LOG X-axis scaling, press the F-2 X-axis LOG pushbutton, and the F-9 FUNC pushbutton.

- (3) To copy a three-dimensional display with LIN X-axis scaling, press the F-2 pushbutton to extinguish the associated LED.
- (4) Press the H-1 PLOTTER CONTROL START pushbutton.

4.3 Running Three-Dimensional Display Operating Procedures

4.3.1 For a CF-300 Not Fitted With a CF-031 Mass Memory Card Option

- (a) Recall to the CF-300 CRT display the analysis data to be three-dimensionally plotted.
- (b) Place the CF-300 in the START condition (i.e., the condition in which the C-1 START pushbutton LED is lighted).
- (c) Press the H-1 PLOTTER CONTROL START pushbutton.
- (d) Press the H-1 PLOTTER CONTROL START pushbutton once again. This initiates the plotter PAUSE condition. After completion of plotting the present waveform, the serial number will be plotted and a page will be fed. This feature can be used when using the trigger feature to allow the plotter to wait for the next analyzed waveform from the CF-300.
- (e) Press the H-2 PLOTTER CONTROL START pushbutton, placing the plotter in the STOP mode. This will stop the presently plotting operation and perform only a page feed.

4.3.2 For a CF-300 Fitted With a CF-031 Mass Memory Card Option

- (a) When Using a 32K Word Time-Axis Waveform Stored in Mass Memory
 - (1) Use E-11 and E-12 to set the CF-300 CRT right-edge character display to OFF.
 - (2) Press the E-6 MASS pushbutton to display the MASS FUNCTION, and select either BASE or ZOOM, entering this selection.
 - (3) Perform the analysis and call up to the CRT the analyzed data to be plotted in three dimensions.

- (4) Place the CF-300 in the START condition (i.e., that condition in which the C-1 START pushbutton LED is lighted).
 - (5) Press the H-1 PLOTTER CONTROL START pushbutton.
 - (6) The remaining procedure is the same as described in section 4.3.1.
- (b) When Using a 32K Word Time-Axis Waveform Stored in Mass Memory
- (1) Store a time-axis waveform in memory following the procedure in the CF-031 Instruction Manual.
 - (2) Replay the stored waveform and display the portion to be copied on the CRT screen. Place the CF-300 in the START condition (the condition in which the C-1 START pushbutton LED is lighted).
 - (3) At step (2), select a value from -2 thru 4 of the CRT right-edge character display and select MASS MEMORY FUNCTION BASE or ZOOM.
 - (4) Press the H-1 PLOTTER CONTROL START pushbutton.
 - (5) The remaining procedure is the same as described in section 4.3.1.
- (c) To Copy the Results of an Octave Analysis
- (1) Press the E-6 mass pushbutton and display the MASS MEMORY FUNCTION. Use E-11 and E-12 pushbuttons to select the OCT function, and enter this selection by pressing the E-10 ENTR pushbutton.
 - (2) Press the E-1 AVG pushbutton and display the AVERAGE MODE. Select EXP SUM (exponential averaging) and enter this selection. Select NUMBER as any value between 2 and 1024 and enter this selection as well.
 - (3) Press the F-1 X-UNIT pushbutton and select either 1/3 octave or 1/1 octave analysis. 1/3 is selected with X-UNIT off and 1/1 is selected with X-UNIT on.
 - (4) Press the D-2 AVG pushbutton to execute the octave analysis.

- (5) Place the CF-300 in the START condition (i.e., that condition in which the C-1 START pushbutton LED is lighted, and press the H-1 PLOTTER CONTROL START pushbutton).
- (6) The remainder of the procedure is the same as for section 4.3.1

4.4 Time Record Operating Procedures

- 4.4.1 Store a time-axis waveform in memory following the procedures in the CF-031 Instruction Manual.
- 4.4.2 Select a value from -2 thru 4 on the CRT right-edge character display and press the C-1 START pushbutton to replay the time-axis waveform.
- 4.4.3 Select the waveform to be plotted following the description in section 4.3 (this is selected by specifying the MASS MEMORY SPEED (1 1024) and the multiplier values from -1 thru 4 at the right edge of the CRT display).
- 4.4.4 Press the E-6 MASS pushbutton to display the MASS MEMORY and select the OTHER FUNCTION entering this selection.
- 4.4.5 Place the CF-300 in the PAUSE condition.
- 4.4.6 Press the H-1 PLOTTER CONTROL START pushbutton.
- 4.4.7 The remainder of this procedure is the same as for CRT COPY.

4.5 Transient Trace

- 4.5.1 Store a time-axis waveform in memory following the procedure in the CF-031 Instruction Manual.
- 4.5.2 Select a value from -2 thru 4 at the right-edge of the CRT display.

- 4.5.3 Press the F-14 SPECT pushbutton and display the spectrum. At this time, the F-2 X-axis LOG button is turned OFF, enabling LIN scaling for the X-axis. A zoomed spectrum can be processed by using E-4 zoom and selecting RECORD.
- 4.5.4 Use the search function to select the frequency of the spectrum to be traced (set F-18 ON and use F-17 and F-15 for this setting).
- 4.5.5 When the F-18 pushbutton is set to OFF, the maximum value will be traced.
- 4.5.6 Press the H-6 MASS pushbutton and display the MASS MEMORY FUNCTION. Select and enter OTHER.
- 4.5.7 Press the C-1 START pushbutton.
- 4.5.8 Simultaneously, press the H-1 PLOTTER CONTROL START pushbutton. Data will be plotted.
- 4.5.9 By pressing the H-2 STOP pushbutton, the plotting can be terminated. Frames and characters are always plotted.
- 4.5.10 Plotting is terminated on the following conditions.
- * When all of the mass memory data has been used.
 - * When the 256th trace has been completed.
 - * Whenever the PLOTTER CONTROL STOP pushbutton has been pressed.
- 4.6 Real-Time Trace
- 4.6.1 Use E-11 and E-12 to select OFF at the CRT right-edge character display.
- 4.6.2 Press the E-6 pushbutton and display MASS MEMORY FUNCTION, selecting OTHER.
- 4.6.3 Press the F-14 pushbutton to display the spectrum. At this time select LIN X-axis scaling (F-2 LED off).

- 4.6.4 If the CF-032 Real-Time Zoom Option has been fitted to the CF-300, it is possible to plot a trace of a zoomed spectrum as well. Display a zoomed spectrum, following the procedure in the CF-032 Instruction Manual.
- 4.6.5 Place the CF-300 in the START condition (i.e., with the C-1 START pushbutton LED on).
- 4.6.6 Use the SEARCH function to select the frequency of the spectrum to be traced (set F-18 ON and make this selection using F-17 and F-15 pushbuttons).
- 4.6.7 When the F-18 pushbutton is set to OFF, the maximum value is traced.
- 4.6.8 Press the H-1 PLOTTER CONTROL START pushbutton. Plotting will begin.
- 4.6.9 The remaining procedure is the same as described in sections 4.4.9 and 4.4.10.
- 4.7 Precautions
- 4.7.1 Once the PLOTTER CONTROL START has been executed (H-1 pushbutton LED lighted), all pushbuttons with the exception of H-1 START and H-2 STOP are inoperative.
- 4.7.2 After executing the START mode, when the last plot is finished, a serial number will be plotted in the lower right hand portion of the copy. This number starts 1 and increments every time the power is applied to the CF-300 or when the SYSTEM RESET is performed.
- 4.7.3 Ensure that a reliable cable connection has been achieved between the CF-300 and the CX-337 Color Plotter. Application of power to these units should be made after this cable connection is made.
- If the CF-300 PLOTTER START is executed with the CX-337 power switch OFF, after the CF-300 PLOTTER STOP switch is pressed, turn the CX-337 power ON. Once again, press the CF-300 PLOTTER START pushbutton switch.

- 4.7.4 With the CX-337 off line (i.e., with the BUSY lamp flashing), PLOTTER START commands from the CF-300 will be ignored. When this happens, place the CX-337 on line, following the procedure in the CX-337 Instruction Manual or switch the plotter off and reapply power, after which the CF-300 PLOTTER START command can be executed once again.

CF-035 Integration and Differentiation
Software Package Option

Instruction Manual

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1. INTRODUCTION

When the CF-035 Software Package is installed into the CF-300, first and second integrations and differentiations can be performed from power spectra obtained with the normal mainframe analysis functions. If the frequency is known, differentiation and integration techniques can be used to ascertain the amplitude of the spectra after the processing if the original frequency and amplitude are known.

$$f(t) = A \sin (\omega t)$$

$$\circ f'(t) = A \omega \cos (\omega t)$$

$$\circ f''(t) = -A \omega^2 \sin (\omega t)$$

$$\circ \int f(t) dt = -\frac{1}{\omega} A \cos (\omega t)$$

$$\circ \int f(t) dt dt = -\frac{1}{\omega^2} A \sin (\omega t)$$

Therefore, when obtaining the power spectrum, the frequency ($\omega = 2 \pi f$) and the power A^2 are determined, making it possible to determine the differential and/or integral of the original signal as well.

If the original waveform spectrum is $P(f)$, the relationships are as follows:

$$\text{*1st differentiated spectrum} \quad (P(f) * (2 \pi f)^2 = P(f) * (2 \pi f)^2)$$

$$\text{*2nd differentiated spectrum} \quad (P(f) * (2 \pi f)^4 = P(f) * (2 \pi f)^4)$$

$$\text{*1st integrated spectrum} \quad (P(f)/(2 \pi f)^2 = P(f)/(2 \pi f)^2)$$

$$\text{*2nd integrated spectrum} \quad (P(f)/(2 \pi f)^4 = P(f)/(2 \pi f)^4)$$

2. OPERATION

2.1 Operating Procedure

- 2.1.1 Use the SET UP FUNCTION (switch E-3) in conjunction with the cursor to set up the menu display as follows.

Meaning	Display	Upper CRT indication
1st integral	$\ast 1/2 \pi f$	(INT)
2nd integral	$\ast (1/2 \pi f) \cdot 2$	(INZ)
1st differential	$\ast 2 \pi f$	(DIF)
2nd differential	$\ast (2 \pi f) \cdot 2$	(DIZ)

- 2.1.2 When the spectrum is displayed, pressing the F-9 FUNC switch will execute the function selected from the above menu.

<Y-LOG>

DB(OFFSET)

FREQ RANGE	FREQ RES	1ST INTEG CONSTANT	2ND INTEG CONSTANT	1ST DIFF CONSTANT	2ND DIFF CONSTANT
1	.005	30.1	60.1	-10.1	-.1
2	.010	24.0	48.1	-4.0	11.9
5	.025	16.1	32.2	3.9	27.8
10	.050	10.1	20.1	9.9	39.9
20	.100	4.0	8.1	16.0	51.9
50	.250	-3.9	-7.8	23.9	67.8
100	.500	-9.9	-19.9	29.9	79.9
200	1.000	-16.0	-31.9	36.0	91.9
500	2.500	-23.9	-47.8	43.9	107.8
1000	5.000	-29.9	-59.9	49.9	119.9
2000	10.000	-36.0	-71.9	56.0	131.9
5000	25.000	-43.9	-87.8	63.9	147.8
10000	50.000	-49.9	-99.9	69.9	159.9
20000	100.000	-56.0	-111.9	76.0	171.9

<Y-LIN>

MULT

FREQ RANGE	FREQ RES	1ST INTEG CONSTANT	2ND INTEG CONSTANT	1ST DIFF CONSTANT	2ND DIFF CONSTANT
1	.005	.3183E+02	.1013E+04	.3142E+00	.9870E+00
2	.010	.1592E+02	.2533E+03	.6283E+00	.3948E+01
5	.025	.6366E+01	.4053E+02	.1571E+01	.2467E+02
10	.050	.3183E+01	.1013E+02	.3142E+01	.9870E+02
20	.100	.1592E+01	.2533E+01	.6283E+01	.3948E+03
50	.250	.6366E+00	.4053E+00	.1571E+02	.2467E+04
100	.500	.3183E+00	.1013E+00	.3142E+02	.9870E+04
200	1.000	.1592E+00	.2533E-01	.6283E+02	.3948E+05
500	2.500	.6366E-01	.4053E-02	.1571E+03	.2467E+06
1000	5.000	.3183E-01	.1013E-02	.3142E+03	.9870E+06
2000	10.000	.1592E-01	.2533E-03	.6283E+03	.3948E+07
5000	25.000	.6366E-02	.4053E-04	.1571E+04	.2467E+08
10000	50.000	.3183E-02	.1013E-04	.3142E+04	.9870E+08
20000	100.000	.1592E-02	.2533E-05	.6283E+04	.3948E+09

Table 1 Constants for Integration and Differentiation in the Various Frequency Ranges

2.2 Spectrum Values After Differentiation and Integration

When the F-9 switch is used to execute the function of differentiation or integration selected as described in Section 2.1, the spectrum waveform and search values obtained from this waveform will change by virtue of the operation performed on the spectrum.

The actual search values are $2\pi f$, calculated as $2\pi f = 2\pi \cdot \Delta f \cdot n$ (Δf : the frequency range resolution), where n is in the range 1 to 200. For the same frequency range, $2\pi\Delta f$ corresponds to the differential and the only variable is n . That is, the differential $2\pi\Delta f$ is added for the LOG vertical display for every vertical value as a value in dB. For LIN display, it is multiplied. For 1st and 2nd differentials, the waveform is displayed with the scaling of the original spectrum, so that the waveform will exceed the scale limits. Thus it is necessary to subtract 20dB from 1st differential and 60dB from 2nd differential waveform scales before display. Also, in 2nd integration waveform indicated scale must be increased up to 20dB from normal scale. Note, however that even though the actual scaling changes, the CRT screen indication of the top and bottom values will not change.

The search values displayed on the CRT screen for the Y-axis are calculated theoretically and are therefore readable as true values. Of course, if the EU function is used, with displacement as the input quantity and the calibration value set to $1\text{mm} = \text{xmV} = 1\text{EU}$, the search value obtained after performing the 1st differentiation will be velocity expressed in units of $1\text{EU} = 1\text{mm/s}$. Similarly, if 2nd differentiation is used, the search value will be acceleration in units of $1\text{EU} = 1\text{mm/s}^2$. The LOG display mode may also be used for the vertical axis, in which case $1\text{Vp-p} = 0\text{dBV}$ (or $1\text{EU} = 0\text{dBEU}$) becomes the reference point.

For LIN vertical axis display, the CRT annotation display will indicate overly large (or small) values resulting from the value ranges:

$0.9999 + 9$ Search point value

or

$0.9999 - 9$ Search point value (excluding 0)

by the notation ????. Note, however, that all values are displayable in LOG mode.

2.3 Directly Reading Physical Quantities After Differentiation and Integration

If the CF-300 EU function (refer to the CF-300 mainframe instruction manual, page), is used, spectrum vertical axis values may be read in terms of velocity using 1st differentiation if an acceleration sensor is used.

Example 1:

An acceleration sensor calibrated to $1G = 500\text{mV}$ is used to provide the input signal to the CF-300 and the spectrum is read in units of velocity (mm/s) or displacement (mm).

The EU value is set to the value corresponding to 1mm/s^2 acceleration. Since $1G = 9800\text{mm/s}^2 = 500\text{mV}$, we have $1\text{mm/s}^2 = (500/9800)\text{mV} = 51 \times 10^{-3}\text{mV}$, from which the value of EU is set to $51\text{E} - 3$.

Single integration is performed and the spectrum resulting is read in units of velocity ($1\text{EU} = 1\text{mm/s}$).

Double integration is performed and the spectrum resulting is read in units of displacement ($1\text{EU} = 1\text{mm}$).

Double integration is performed and the spectrum resulting is read in units of displacement ($1\text{EU} = 1\text{mm}$).

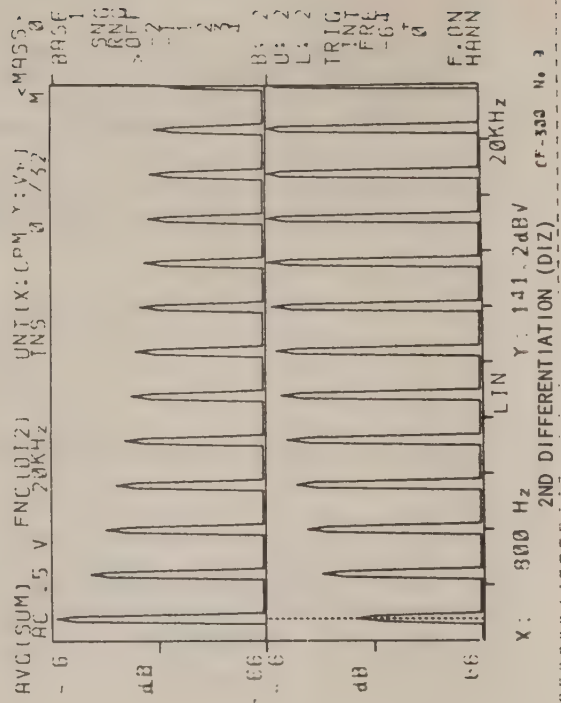
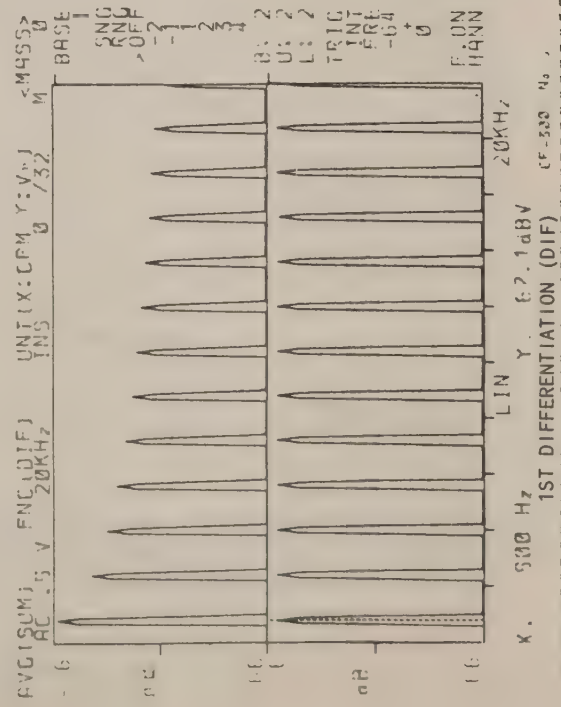
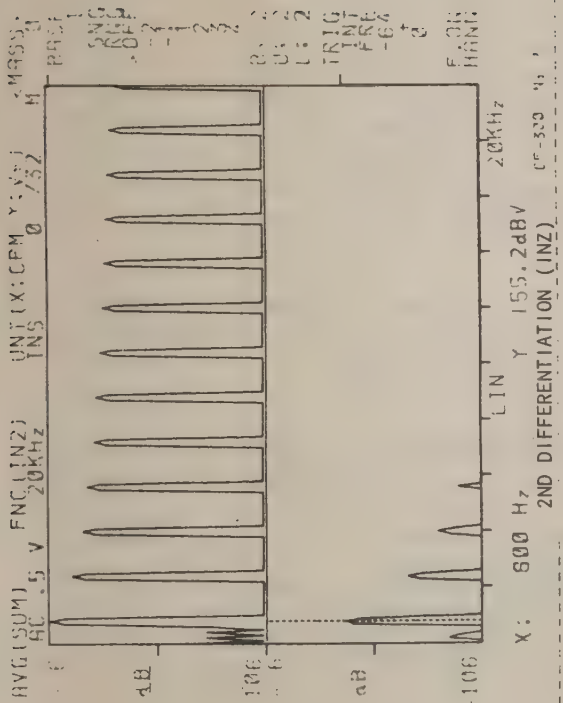
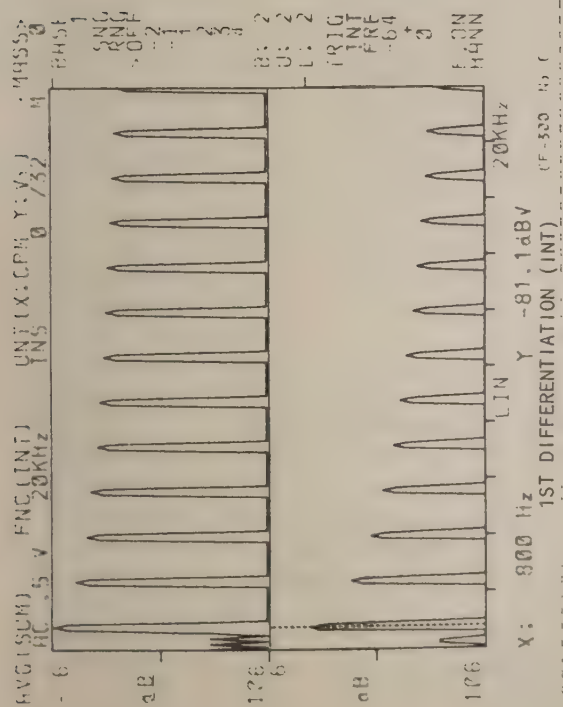
Example 2:

A displacement sensor calibrated to $1\text{mm} = 5\text{V}$ is used as the input for the CF-300 and used to read velocity in units of mm/s and acceleration in units of mm/s^2 .

The EU value is set to that value which corresponds to 1mm of displacement. In this case, since $1\text{mm} = 5\text{V} = 500\text{mV} \times 10^0$, we make the setting $5000\text{E} + 0$.

Using single differentiation, the resulting spectrum is read in units of velocity ($1\text{EU} = 1\text{mm/s}$).

Using double differentiation, the resulting spectrum is read in units of acceleration ($1\text{EU} = 1\text{mm/s}^2$).



CF-036 A-Weighting Option

Instruction Manual

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1. INTRODUCTION AND SPECIFICATIONS

This option is designed to perform A-weighting on the octave analysis results obtained with the CF-300 using the mass memory feature (Option CF-031).

Analysis is performed and then the A-weighting is set to ON, allowing the convenient monitoring of the results without the weighting as well.

Ranges with which A-weighting may be used:

20kHz (6.3Hz to 20kHz)
10kHz (2.5Hz to 10kHz)

The A-weighting characteristics are give in the table below.

Center frequency	20K	16K	12.5K	10K	8K	6.3K	5K	4K	3.5K	2.5K
Weighting (dB)	-9.2	-6.5	-4.2	-2.4	-1.1	-0.1	+0.5	+1.0	+1.2	+1.2

2K	1.6K	1.25K	1K	800	630	500	400	315	250
+1.2	+1.0	+0.6	0	-0.8	-1.9	-3.2	-4.8	-6.5	-8.6

200	160	125	100	80	63	50	40	31.5	25
-10.8	-13.2	-16.1	-19.1	-22.3	-26.1	-30.2	-34.5	-39.2	-44.6

20	16	12.5	10	8	6.3	5	4	3.15	2.5
-50.4	-56.7	-61	-66	-72	-	-	-	-	-

Weighting Characteristics

The errors with respect to the values in the above table are as follows:

The error with application of A-weighting at -50dB, -64dB and -72dB with respect to the input range fullscale are within the following limits.

0 to -50dB: +0.1dB
-50 to -64dB: +0.3dB
-64 to -72dB: +1 to -3dB

2. OPERATION

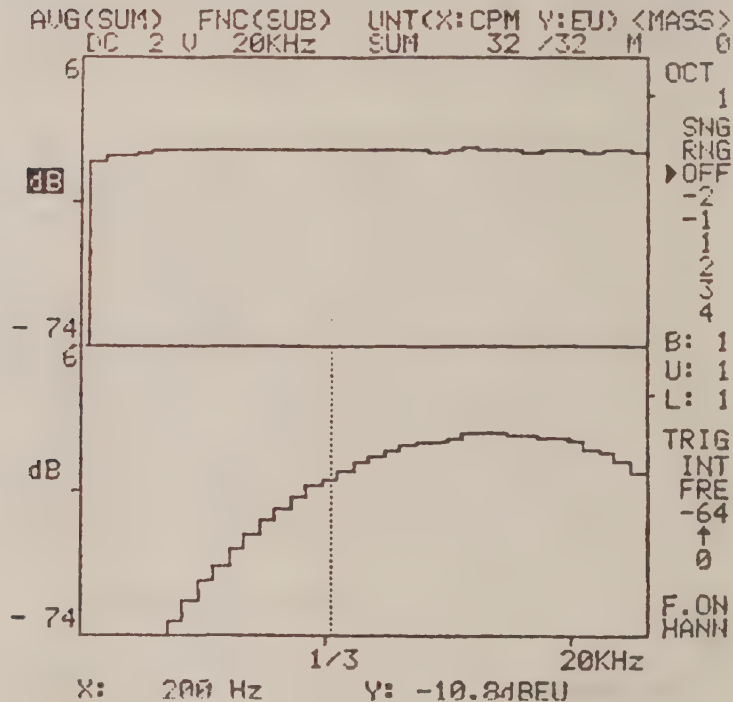
2.1 Perform a normal 1/3 or 1/1 octave analysis.

2.2 To apply A-weighting, set the X-LOG (F-2) mode ON (this is possible with either 1/3 or 1/1 octave analysis results).

2.3 To view the original non-weighted spectrum analysis results, simply set the X-LOG (F-2) OFF once more.

Note 1. This weighting function is ignored in any other range than 10kHz or 20kHz.

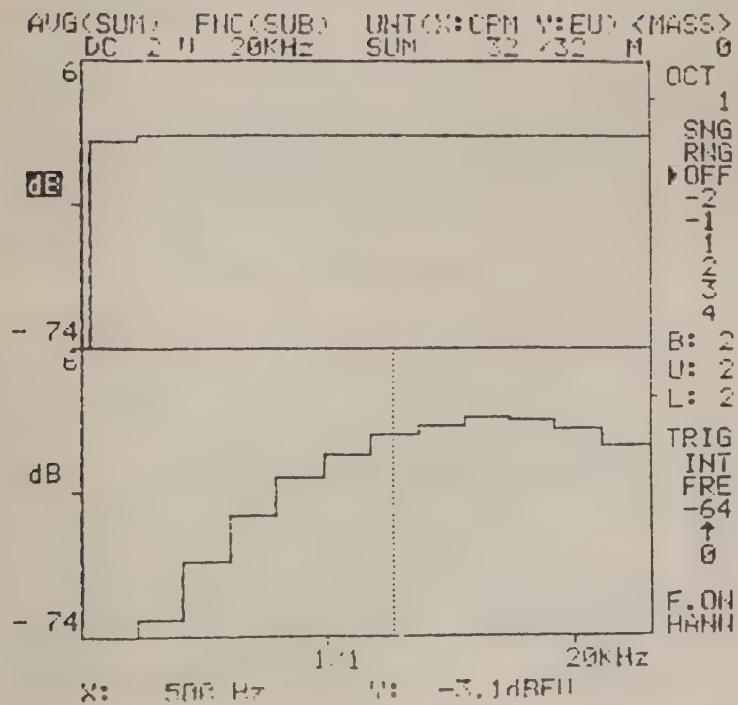
2. The overall value will change as well as the individual spectral components. In the peak mode, however, the overall value remains the same.



Example display 1

Upper: Pink noise 1/3 octave analysis results (THRU mode)

Lower: Pink noise 1/3 octave analysis results (with A-weighting)



Example display 2

Upper: Pink noise full octave analysis results
 (THRU mode)
 Lower: Pink noise full octave analysis results
 (with A-weighting)

CF-037 Scrolled Three-Dimension
Display Software

Instruction Manual

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1. INTRODUCTION

The CF-037 Scrolled Three-Dimensional Display Software Option enables three-dimensional spectral displays to continue beyond the normal limitation of 24 displays.

Scrolling is performed every four spectra and real-time performance is the same as with the standard specifications.

1.1 Description of Scrolled Three-Dimension Display

The standard three-dimension display is limited to 24 spectra. In contrast to this, using the CF-037, the 24 spectra are displayed, after which the first four are erased, the remaining 20 spectra are lowered and four new spectra are displayed in place of the four erased spectra. The effect of this sequence is illustrated in Fig. 1 and Fig. 2.

The process of erasing four old spectra and replacing with four new spectra is repeated to create a three-dimensional display, until the PAUSE condition is enabled.

Note 1. The standard three-dimensional display and the scrolled three-dimensional display may be switch selected.

2. Since the processing speed does not change, the time interval is the same as with the standard three-dimensional display. In effect, there is no loss of time by using the scroll function.

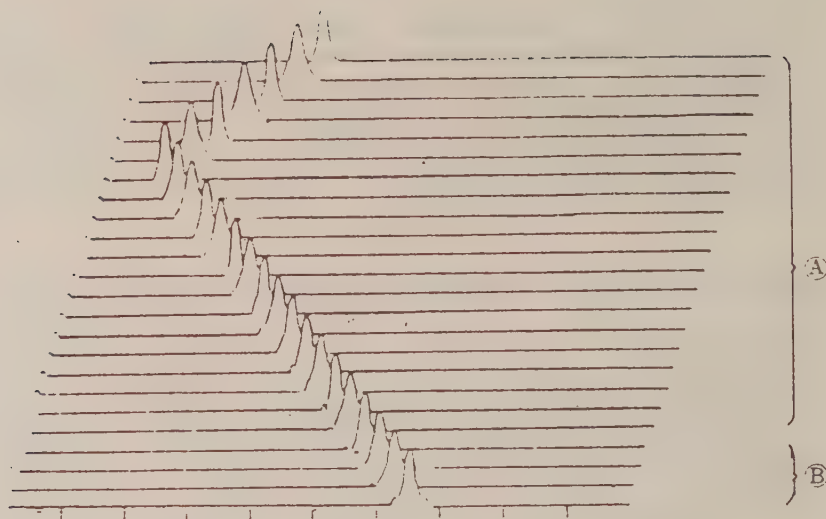


Fig. 1

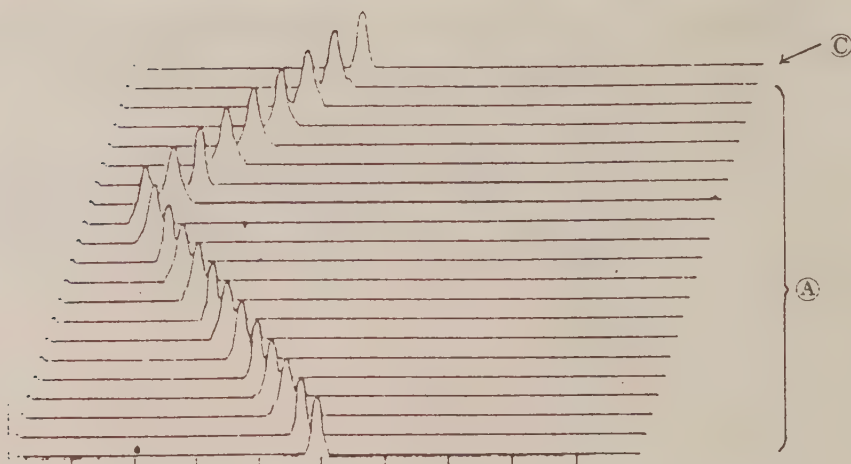


Fig. 2

Description of the Updating Sequence:

- * A normal 24-line three-dimensional spectral display is shown in Fig. 1.

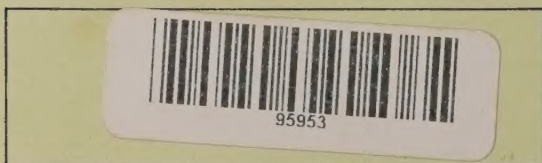
* Of the 24-line display, the four lines at B are erased and the remaining 20 lines at A are scrolled downward.

* In Fig. 2 we see that one new spectral line has replaced an old spectral line at the top of the display at C. (As long as the PAUSE pushbutton is not pressed, another three spectra will replace the erased lines.)

2. OPERATION

- 2.1 Press the E-3 SET UP FUNC pushbutton, and use the cursor to select ARRAY, entering this selection using the E-10 ENTR pushbutton.
- 2.2 Using the F-18 SEARCH ON/OFF pushbutton, select either the scrolled three-dimensional display or the standard three-dimensional display as follows.
 - SEARCH ON: Scrolled three-dimensional display
 - SEARCH OFF: Standard three-dimensional display
- 2.3 Press the F-9 FUNC pushbutton and execute a three-dimensional display.
- 2.4 Press the C-2 PAUSE pushbutton to stop the scrolled three-dimensional display.

- Note 1. Depending upon the timing of pressing the PAUSE pushbutton, the Y-axis may not be displayed when the CRT screen is stopped. (This occurs when the PAUSE pushbutton is pressed after a scroll but before a new spectral line is displayed.)
2. Used in combination with the CF-031 Mass Memory Card, it is possible to provide a scrolled three-dimensional display of recorded transient waveforms.
 3. Scrolled three-dimensional display is not possible if the F-9 FUNC ARRAY MASS is selected.



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